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JPRS-UMA-86-023

21 APRIL 1986

USSR Report

MILITARY AFFAIRS

FOREIGN MILITARY REVIEW

No 11, NOVEMBER 1985

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Except where indicated otherwise in the table of contents, the following is a complete translation of the Russian-language monthly journal ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, published in Moscow by the Ministry of Defense.

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PUBLICATION DATA

English title	:	FOREIGN MILITARY REVIEW, No. 11, 1985
Russian Title	:	ZARUBEZHNOYE VOYENNOYE OBOZRENIYE
Author (s)	:	
Editor (s)	:	I.I. Bugrov
Publishing House	:	Voyenizdat
Place of Publication	:	Moscow
Date of Publication	:	November, 1985
Signed to press	:	11 October 1985
Copies	:	
COPYRIGHT	:	"Zarubezhnoye voyennoye obozreniye", 1985.

AUTOMATED TROOP CONTROL SYSTEMS EXAMINED

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 85 (Signed to press 11 Nov 85) pp 3-10

[Article by Col I. Loshchilov; "Troop Control Automation"]

[Text] Imperialism's strategy now displays an openly aggressive character and envisions the sweeping use of military power as the chief instrument for achieving world domination. The armed forces of the U.S. and the other NATO countries have the mission of being prepared to carry out aggression in any region of the world. For these reasons the might and combat readiness of the imperialist states' armed forces are being enhanced and enormous amounts of money are being spent.

The combat strength of a modern army depends, to a large degree, upon the level of development of control and combat (operational) support systems which are seen more often by foreign specialists as a unique "multiplier" of combat-ready forces. The level of development of these systems, in turn, is determined by the degree of automation which is one of the decisive factors for success in battle. Therefore, intensive efforts are being exerted in the imperialist states' armed forces to further develop and improve troop control systems.

The U.S. armed forces are characterized by the highest level of automation in the control process, in which computer technology is used in practically all spheres of military activity. According to foreign press reports, there are, at the present time, in excess of 7,500 general purpose computers (the number has doubled in the last decade) in staff units and other facilities. These automated units are supplemented by tens of thousands of specialized computers used in weapons systems and military equipment. American specialists estimate that by 1990, the U.S. armed forces will have 86,000 of these devices: 13,000 in the ground forces, 40,000 in the air force, and 33,000 in the navy. An especially large increase has been noted in the number of computers in areas such as control and intelligence.

In 1972, 3.4 per cent of these general-purpose computers were used in troop control, in 1982 it was 14 per cent, and at present, it has reached 17 per cent. They are the basis of various types of automated control systems (ACS)

and are used to automate the more tedious control tasks. The foreign press notes that ACSs are used in practically al areas of control.

This article examines the more typical systems.

In order to provide strategic control, the U.S. created the Worldwide Military Control System (WWMCS) and, which, judging by the Western press, combines more than 100 strategic control units. WWMCS is noted for its rather high level of automation: it has more than 500 computers whose aggregate computing power approaches 1 billion operations per second. Computer centers were established for the strategic control units to handle various control functions. The most powerful of them have 10-27 computers.

Automationm of the WWMCS system began in the latter half of the 1960s. The primary targets of automation were operational units of the Air and Space Defense Command (ASDC), the Strategic Air Command (SAC), the Joint Chiefs of Staff (JCS) and service headquarters. The computer centers of these organizations served as a basis for ACSs which collect, store, process and display to a command both operational and intelligence data and which also do calculations for planning, transmit orders and disseminate commands to the troops.

The initial development of such control systems was done independently by a number of agencies and was poorly coordinated. The foreign press reports that this resulted in WWMCS operational units being equipped with ACSs which used different hardware and data processing methods.

By the late 1960s, the WWMCS had almost 160 computer centers which used 30 different programming systems and nearly 40 types of computers made by a variety of companies. All this led to a delay in the exchange of information, high operating costs, increased software support costs and difficulties in the training of personnel which serviced the equipment.

In the 1970s, the U.S. Defense Department leadership began work to make the computer centers serving the WWMCS units compatible. For this, a special standardization program was adopted, the essence of which was to choose a basic computer, centralize its procurement, and supply it to the WWMCS operational units. The Honeywell H6000 was chosen as the base unit, and there are now almost 50 of them in the WWMCS system.

The program heads reaffirm that the installation of standardized devices within the WWMCS operational units has significantly increased their ability to resolve the following specific problems.

The JCS is involved in developing joint operational plans and plans for the strategic deployment of the armed forces, and the preparation of summarized evaluations of the combat readiness state of the headquarters, troops and naval forces.

SAC headquarters periodically adjusts the distribution of personnel and resources in accordance with a single joint operational plan for destruction

of strategic targets and evaluates and displays the state of combat readiness of the strategic offensive forces.

The ASDC headquarters processes and summarizes information received from nuclear missile attack warning systems as well as tracks satellite and other space object trajectories.

In the troop command staffs, operational plans for strategic troop deployment are developed and problems of transporting strategic reserves are worked out.

The headquarters of the U.S. European, Pacific and Atlantic Unified Commands, are involved in the development and adjustment of operational plans for actions in emergencies, the planning operations in the TVD and the combat use of nuclear forces in theaters of war, as well as performing operational analyses.

In the latter half of the 1970s, the following step was taken on the way to solving the coordination problems of WWMCS operational units' ACSs: the creation of a joint information system was started, which, by using a common database, must solve a number of related problems by standardized methods of operational control of armed forces simultaneously in the immediate interests of several control units.

The necessity of undertaking such a large-scale measure in order to provide strategic control is determined by the fact that the collection, processing and output of information for operational planning, decision making, briefings on combat missions and the organization of coordination between headquarters and troops is a continuous process in which a large number of control units participate simultaneously. Many of them use the same initial data and identical processing and analyses methods. Consequently, if one can extract from this list of tasks those which are common to several operational units, create a common data base for them and develop common solution methods, then one can, as the American specialists believe, cut down on duplication to a large degree, increase the completeness and reliability of the output and improve the quality of the decisions being made.

The creation of a joint WWMCS information system presupposed above all the choice of a system-wide technical base which supports the processing and mutual exchange of information files. The territorially distributed computer network called WIN (Worldwide Information Network), which had to connect, by high-speed communication channels, the computer centers (CC) equipped with standard computers was chosen as such a base. The foreign press announced that the WIN network began operation in 1978, and, at present, it includes 20 CCs (of the 26 equipped with standard computers).

Simultaneously with practical testing of the WIN system's basic operating procedures during various command staff exercises, work began on the creation of the WWMCS information system itself. The Joint Chiefs of Staff approved a number of specific tasks to be solved by the system, as standards. They include evaluation of the state of the armed forces, operational planning, analysis of intelligence data, a comprehensive evaluation of the after-effects

of a nuclear strike, preparation of reports and combat orders, nuclear weapon accounts, a general evaluation of military resources and other tasks.

Special data bases were set up to solve these tasks. The largest of them, providing troop status evaluations and operational planning, are already in use and greatly simplify staff work. For example, the upper level military units receive daily detailed reports reflecting the state of the forces and the whole cycle of unified planning associated with the adjustment and joint refinement of all the commands' plans has been shortened to 15 days.

However, on the whole, the experience of using the WIN computer network and checking it during a number of large-scale exercises revealed significant deficiencies caused by inadequate computer reliability, programming errors, poor practices on the part of the operational teams and a low degree of data protection.

The deficiencies uncovered became public and drew the attention of financial control organs and a congressional commission. In connection with this, the Pentagon developed a plan to modernize the WWMCS information system and all work on automating it was consolidated in the special Worldwide Information System (WIS) program. The latter is intended for use in the period up to 1990, and includes measures in the following areas:

-- OPERATIONAL--to specify tasks to be resolved by the automated devices in support of various WWMCS organs, with an emphasis on the more effective use of this equipment for control in crises situations and during military operations.

-- INFORMATIONAL--to refine the information requirements of the WWMCS units, establish special data bases and their control system, devise and implement reliable data base protection methods.

-- ORGANIZATIONAL-TECHNICAL--to complete full-scale development of the WIN computer-network and use it to service the new automated data transmission system called the Defense Data Network (DDN); establish computer centers which meet the needs of each command and support them on the computer network; bring on line a number of special-purpose functional sybsystems; make the computer network compatible with operational-tactical units' ACS and other military computer networks.

-- Technical--to replace existing automation devices with a new generation of equipment, develop programming support, implement a number of the latest advances in scientific and technical progress (tele-conferencing, "electronic mail," fiber optic devices for communications within a computer center (CC), etc.)

Plans call for expenditure of no less than 1.5 billion dollars to modernize the WWMCS information system.

The principles and technical designs underlying the WWMCS information system are widely used in creating the ACS, which supports the activities of the headquarters and control points of the strategic sections of the North

Atlantic bloc's management (from NATO's Supreme Command to army groups, (OTAC included), and is called the Automated Command and Control Information System (ACCIS). Plans call for this large-scale system to include about 50 fixed and mobile computer centers linked by high-speed data transmission lines. Each of the CCs would be a local network, comprising 3 high-power computers performing 2-3 million operations/sec. (the mobile CCs are smaller and less powerful) and a number of auxiliary processors (for generating and updating data bases, processing messages, suporting executive personnel, generating standard messages, etc.), a group of automated work stations and terminals for displaying and printing information and various pieces of communications equipment. As with the WIS system, there are plans to use a number of common data bases and unified processing programs. In particular, it is envisioned to solve problems on the assessment of troop combat readiness, operational planning, dissemination of intelligence information, and recording and coordinating orders to employ nuclear weapons. The procedures for generating and exchanging common files, rules for accessing them, the data base management system, distribution network operating system, and the methods of multi-level information classification will be the same as those of the WIS system. Full-scale implementation of the ACCIS ACS is expected in the mid-1990s.

Foreign specialists believe that the transition to operational use of territorially-dispersed computer networks possessing a high degree of survivability in a nuclear missile attack and great capabilities for solving strategic problems signifies a qualitatively new stage of control automation at a high level.

Work is proceeding intensively on automation of troop control in the operational-tactical units. The foreign press reports that there are more than 150 designations for ACSs of this type, however, the majority of them are still in the development stages. The practical application of automated systems by the forces is limited by the tactical unit, weapon and equipment control as well as the MTO logistics forces and equipment. The introduction of ACSs for formations and intelligence groups and systems designed to be used in the operational units lags significantly behind previously mentioned dates.

The present stage of automation in the U.S. and European NATO countries is devoted to assuring the compatability of differing national ACSs for extensive use within NATO's joint arms forces in a TVD. The unique characteristics of the development of automated equipment are: greater centralization of processing operational and intelligence information; use of this information chiefly at the corps or army level in order not to overload the lower level units with technical equipment; creation of special international ACSs (for transmitting command-signal information, automatic target location determination, etc.); creation of reconnaissance-strike complexes to match the technical capabilities of target information collection and processing units with the means to destroy them.

At present, the highest level of automated troop control in the operational-tactical unit, as confirmed by SIGNAL magazine, has been achieved in the Central European TVD where powerful NATO joint arms force groupings have been established. More modern ACSs are being developed in order to control them.

For example, those designed for ground forces are called upon to control combined arms formations, the forces and resources of the field artillery ACS, anti-aircraft forces and resources, and intelligence and rear support.

The U.S. is developing several automated systems to control combined arms formations. One of them, the Maneuver Control System (MCS) was designed to process, store, and disseminate operational messages between command posts as well as within them. Its base is six compatible modules which can access the corps, division and brigade command posts' automatic data processing devices. Additionally, terminals for units and subunits subordinated to a division or corps are envisioned. The automation devices are located in control center staff vehicles. They provide for generation, storage, retrieval and dissemination of formalized messages; display of the combat situation on maps scaled 1:50,000 and 1:100,000; and production of operational calculations.

The SIGMA system is intended to solve problems of an informational nature. It was designed to support the activities of corps and division staffs, and in conjunction with the MCS system, to solve problems for lower-level organs. Besides this, through the use of this system, specialists plan to tie in all functional ACSs of the service branches and other services into a single formation ACS, which will process and analyze all incoming information with the aid of common files. The technical basis would be 6-7 mobile CCs forming a territorially-dispersed computer network for an army corps. The information files would be duplicated several times to assure a high degree of survivability.

New automated devices are being designated to replace the Tactical Operation System (TOS) combat action ACS, but they are in various stages of development. For example, MCS is undergoing experimental testing and in the near future may be put into service. Completion of the SIGMA progrem is set for no earlier than the 1990s. Functions of the future ACSs will provide special systems. The most interesting of them is the Position Location and Reporting System (PLRS). It is designed to calculate automatically the coordinates of ground and air objects and to provide commanders with data on the position of subordinate and support subunits. The division level system includes a control center and 370 terminals.

Two combined arms ACS systems, the British WAYBELL and the West German GEROS are compatible with the American MCS system. The former is in use, the latter is in testing, and is expected to be adopted in the late 1980s.

To control troops and field artillery, an ACS is being developed and built which supports planning for artillery fire, reconnaissance and target analysis, preparation of firing data and collection and analysis of situation and manning reports from organic subunits (in the U.S.--the TACFIRE system, in the FRG--the ADLER system, and in Great Britain--the BETTS system). They are based on mobile computer centers, assigned to the control organs of corps and divisions, as well as field artillery brigades (groups) and divisions. The unit control center, as well as the artillery reconnaissance subunits are equipped with special terminals. Direct control of weapon systems is achieved with the aid of specialized ACSs: (The U.S.: Battery Computer System (BCS),

the West German Integrierten Feuerleitmittel Artilleriebatterie (IFAB) and the British Field Artillery Computer Equipments (FACE).

The American TACFIRE field artillery ACS entered service and was deployed in formations stationed in Europe, and the ADLER and BEITS ACSs are expected to be introduced in 1985-1987. Further efforts are directed toward the integration of the ACS with artillery reconnaissance systems and the creation of reconnaissance strike complexes based on them. It was announced that special programs have been worked out (in the U.S.--AFATDS, in the FRG--AFFS) which are supposed to be completed in the early 1990s.

Ground forces ACSs must support fire planning for tube artillery and air defense batteries, the centralized distribution of air target information between them, and the preparation of initial data. In the U.S. Army, they will consist of two subsystems. The first is designed to control long- and mid-range air defense batteries. It is based on the existing American Missile Minder ACS system embracing air defense artillery brigage (group) control posts and division air defense missile batteries. Use of this system provides control of air defense batteries on 96 special channels (with a cycle no greater than a 20-25 sec.). The second subsystem--Short Range Air Defense Command and Control (SHORAD C^2)--was designed for controlling short-range air defense batteries and self-propelled air defense missile batteries and must provide for their centralized control at the division level. The GFAFS system is being built in the FRG for a similar purpose. It is anticipated that it will be accepted into service in the latter half of the 1980s.

Automatic processing of intelligence data is one of the functional areas in which intensive work is being carried out. Foreign specialists believe that this has occurred because the ability of modern technical means to obtain information about the enemy does not match the ability of a staff to process it. The U.S. has developed a corresponding concept which proposes unifying and centralizing collection, processing and dissemination of intelligence information within a TVD. The All Source Analyses System (ASAS) occupies a central position in this. It must support processing and comprehensive evaluation of information on the enemy with periodic updates: in a TVD--twice a day (with target reconnaissance to a depth up to 1,000 km), in an army corps--every hour (up to 300 km), and in a division--every half hour (up to 150 km).

As reported in the Western press, a special variant of this system was developed which consists of three automated centers for correlational processing of intelligence data for an air army, army corps and division. Field tests conducted in 1981-1983, pointed to the possibility of using such centers to create a network to support centralized processing, analysis and dissemination of intelligence information right down to the unit level. The ASAS system is to be in placed in service in the early 1990s.

Automation of collection, processing and dissemination of intelligence information at the brigade and battalion level is to be carried out in accordance with the VISTA program. It proposes that a system be set up to reproduce the combat situation at a depth of 30-40 km from the FEBA and send intelligence information to the control organs and target designation data to

combat units. It is envisioned that the data will be processed using interlinked automated posts (6-7 in the division area). It is believed that this system will be in place in the latter half of the 1990s.

The Bundeswehr is building similar systems. So, after 1990, an ACS which connects all forces and ground troop intelligence resources is to be in place. It is proposed that in the future the results of efforts to automate intelligence units and subunits in the U.S. and FRG armies will be utilized by the other bloc countries.

To handle rear support problems, the American army has been using the combat service support system (CS3) for almost ten years. It automates the more laborious processes in ground forces logistics, supply and equipment repair, reports on manning and transportation and provision of medical treatment. It includes several fixed CCs in the communication zone, mobile CCs in the army corps and divisions, and automated posts directly in rear units and subunits. At present, modernization work is going on during which it has been proposed to expand rear units' and subunits' capabilities to adapt the information locally through the wide use of small computers, replace outdated equipment in the mobile CCs, consolidate programming support, replace bulky fixed CCs with mobile ones, and relieve rear operational organs by transferring certain support tasks to higher levels. Foreign specialists believe that the updated version of the system will be deployed by the latter half of the 1980s.

ACSs designed for tactical air control are American and West German developments and are being completed in accordance with a NATO-wide program.

The U.S. armed forces have created and already introduced the 485L tactical aviation ACS. It supports collection, processing and display of information on the air situation, the state of one's forces' combat readiness, air operation planning, air traffic control, direct air support problem solving, and coordination between army aviation and air defense resources. The system is comprised of a ground control network, radar posts, communication nodes and auxiliary equipment. Its centerpiece is the Tactical Aviation Control Center (TACC) equipped with the West German EIFFEL-1 ADP device. The latter was designed for the FRG Air Force Tactical Aviation Command. It consists of three CCs and associated display terminals distributed among air force units. Western specialists believe that the next development program--EIFFEL-2--provides for an increase in the number of CCs up to 10-20, and broadens the number of control units being serviced. The improved system is expected to be in service in the second half of the 1980s.

Ground control systems are supplemented by airborne ones designed for long-range radar detection of air targets, control and guidance (AWACS). Such systems are installed on American E-3A and British NIMROD aircraft.

In order to provide operational communications between surface and airborne installations in the control system, American specialists developed a joint tactical communication and data distribution system, the Joint Tactical Information Distribution System (JTIDS), which was adopted as the basis of a NATO-wide system named MIDS. Characteristic of the latter is the ability to provide anti-jamming measures and secure communications for a large number (up

to 2,000) of users. It is believed that it will be in service in the first half of the 1990s.

The foreign press notes that the presence of a large number of national and NATO-wide systems, devoted to controlling joint air force groups, caused a problem in assuring compatability and coordination. It was proposed to handle this primarily within the framework of the ACSs of the joint NATO air forces in the Central European TVD, designated the Air Command and Control System (ACCS) which is comparable in scope with ACCIS. This major NATO-wide program is expected to be implemented in the mid-1990s.

Work is actively proceeding on automation of the control of naval forces. The U.S. has developed and begun to implement a long-term plan to develop a single automated naval operational control system--the Naval Command Control and Information System (NCCIS). It is based on the following components:

--automated units serving the Fleet Command Center (FCC), deployed at navy headquarters, the headquarters of the Commanders-in-Chief Atlantic and Pacific and the Commander, U.S. Naval Forces Europe--all of which are part of WWMCS;

--flag command posts, designed for deployment aboard ships which can serve as flag ship;

--the Integrated Tactical Surveillance System (ITSS) being created by integrating all resources for collecting information on the surface, underwater, and air situation (it envisions assurance of compatability, and subsequently of linking the existing oceanic TVD surveillance systems, intelligence data processing systems, ASW control centers, and weather service offices).

--The long-range naval communications system--naval telecommunications system (NTS) which must be composed of highly automated shore and shipboard communication nodes, equipped with message processing and routing devices, as well as varied types of multiplex redundant communication lines;

--Shipboard ACS, chief of which is the unified shipboard installation, developed on the basis of the extended use of the CIC, the Naval Tactical Data System (NTDS), and the results of tests on new designs (e.g., OUTLAW SHARK).

In characterizing the present stage of development of automation in the armed forces, foreign specialists believe its chief feature to be the growing orientation towards management activities processes. While earlier ACSs were oriented towards the specific requirements of individual commands, service branches and services, today most attention is turned to the control processes (collection of information, planning, analysis of the situation, etc.) in which various command, support and other organs participate. This feature has led to: use of territorally-distributed computer networks to handle a number of general tasks; the appearance of joint (including multinational) ACSs at the lowest organizational levels; integration of separate types of functional activities, especially those such as control, communications, reconnaissance and EW.

The arms race being carried on by the Pentagon, has recently been transferred to space which greatly threatens the people's security. During this militarization of space, which threatens the course of world peace, the U.S. is paying more attention to the development of control systems for space weapons.

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CSO: 1801/87

STINGER PORTABLE AIR DEFENSE MISSILE SYSTEM DISCUSSED

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 85 (Signed to press 11 Nov 85) pp 23-28

[Article by Lt Col M Vanin; "The Combat Use of the Portable STINGER Air Defense Missile System"]

[Text] The U.S. military and political leadership, in its pursuit of the arms race on an unprecedented scale, has assigned an important place to further improving air defense, one of the primary forms of ground troops protection.

Foreign military specialists believe that organization and effectiveness of air defense in formations, units, and subunits substantively affects their combat operations. Hence, in their view, under modern conditions one can never count on success in battle without reliably being able to protect troops from enemy air strikes, particularly those at low and extremely low altitudes. The solution to these problems relies upon short-range air defense missile systems (ZRK) including portable ZRKs (PZRK). The conduct of research, and the verification of its results in various exercises, as well as the study of experience from local wars have led American weapon experts to conclude that PZRKs can be effectively used against low-flying air targets. It has likewise been noted that their small weight and dimensions allow them to be used in conditions where the use of other air defense weaponry would be difficult or impossible (in mountains, forests, swamps, etc.)

The foreign press notes that troop air defense is curently undergoing significant changes. Within the framework of the measures in the "Army-90" program, it is anticipated that new and modernized existing air defense weaponry will be put into service, that the organizational and organic structure of air defense units and subunits will be improved, and that new methods and ways of conducting troop activities will be developed. In particular, since 1981, the STINGER PZRK is being put into service in the ground forces to replace the RED EYE PZRK. As a modern air defense weapon, it is intended primarily for indirect protection of forward subunits and mobile rear targets from enemy air strikes at low and extremely low elevations in all kinds of combat.

Foreign specialists note that the need for replacing the RED EYE with the STINGER system was due not only to the improved tactical and technical

specifications of the latter, but also due to the change in the organization of the respective subunits. The RED EYE PZRK, partially found in the regular forces and most recently, even in service in the units and subunits of the ground forces reserve elements, was part of the inventory of combat, reconnaissance, and field artillery battalions. STINGER PZRK subunits, however, are organizationally incorporated into air defense units and subunits, including the air defense battalions in all types of divisions[1]. Such a centralization of air defense assets, as noted in the foreign military press, increases the capability to control them during the battle, leads to a more flexible use of air defense assets to cover the most important targets, allows one to increase the interaction and teamwork among air defense subunits, as well as increasing their level of combat readiness.

The basic firing entity of the STINGER PZRK are the crews which are formed into sections, which, in turn, are organized into platoons that are part of air defense battalions. The organization of the platoons depends upon the organic structure of the formations and units. Hence, the air defense battalion of future mechanized (armored) divisions, it is anticipated, will contain five platoons, each of which will contain a control section and three sections of five crews each. The air assault division's air defense batallion is planned to have six platoons (one section made up of five crews and one with six). An airborne division will have four platoons with four sections each (and four crews per section). A detached armored cavalry regiment will have a PZRK platoon within the air defense battery and will contain seven sections with four crews per section.

The number of PZRK crews in formations and units of existing and future organizations is shown in Table 1.

As reported in the foreign military press, a component of the portable air defense missile system is a FIM-92A STINGER air defense guided missile housed in a transporter-launcher container. It also has a friend-foe identification device. The container has an optical sight attached to it which is used for visual lock-on and target tracking for determining range and for introducing lead angle when the missile is launched. The identification device's antenna is mounted on the body of the launcher while the remaining elements are assembled in a separate unit that can be carried on a belt strap and which attaches to the launching device by means of a special cable. In order to increase the system's resistance to jamming, a new air defense guided missile has now been developed and is being put into service that is equipped with a homing head that works on the infrared and ultraviolet wave bands.

Table 1

THE NUMBER OF PZRK CREWS IN DIVISIONS AND DETACHED UNITS

TYPE OF FORMATION OR UNIT	CURRENT ORGANIZATION	FUTURE ORGANIZATION
	RED EYE	STINGER
Mechanized Division	67	75
Armored Division	72	75
Infantry Division	68	*
Airborne Division	64	68
Air Assault Division	62	64
Detached Armored Cavalry Regiment	22	28

* 90 STINGERs in Light Subunits

A STINGER crew (commander and gunner) is outfitted with communications equipment, and carries an ammunition load of ten guided missiles in transporter-launcher containers carried about on "jeep" vehicles. It is able to fire simultaneously at two single targets or one group target standing still or in motion, either head on or by overtaking them. The missile can fire on and destroy targets with a probability of 0.4-0.6 when flying at speeds up to 400 m/sec at ranges of 500-1,000 m (head on) or up to 5.200 m (overtaking) and altitudes from 30 to 3,500 m. Comparative tactical and technical specifications for the portable STINGER and RED EYE PZRKs shown in Table 2.

The commander of the section, who is located in the command post of the subunit being protected by the section, controls the activities of the crews and how they are deployed. In the case where the crews are assigned to companies (batteries) or platoons, the firing positions are selected and operated according to these subunits commanders.

Table 2

BASIC TACTICAL AND TECHNICAL SPECIFICATIONS OF PORTABLE AIR DEFENSE GUIDED MISSILES

Designation	PZRK	
	STINGER	RED EYE
Firing range, m		
Maximum, overtaking	5200	4100
Maximum, head-on	1000	—
Minimum	500	600
Target altitude at intercep[t]		
Maximum	3500	2500
Minimum	30	30
Maximum target speed, m/sec	400	230
Maximum missile velocity, m/sec	700	530
Time to put system into firing position, sec	30	30
Kill probability	0,4—0,6	0,3—0,5
System weight (in firing position), kg	13,5	13,0
Type warhead	HE	HE
Warhead weith, kg	1,0	0,5
Length of transporter-container, mm	1520	1280

The commander of a PZRK section makes his decisions on the basis of information he receives from the air defense warning network and from the subunit he is covering. Data on the air situation can also come from radar which picks up low-flying targets and is being deployed in the sections' area of operations. To operate the system, each section (commander) has a portable range finder, on the screen of which is illuminated transmitted information in the form of pips of aerial targets: red pips refer to enemy planes and green--one's own. In the course of combat operations, the crew is controlled by radio and line communications. American military specialists believe that line communications are the most convenient and reliable; however, they are best used only in the defense. It is considered that in selecting a target to fire upon, one has to adhere to the following basic rules: Open fire first and foremost on a target which poses a threat and at its maximum range; keep firing until the target is destroyed, stops attacking, or stays outside the range of the PZRK; and refrain from firing when one's own aircraft are in the air in direct proximity to enemy planes (helicopters).

In combat, PZRK crews perform their missions, as a rule, as part of a subunit or independently. The crew commander maintains direct fire control. Targets are selected autonomously or based on commands transmitted by the section commander through communications channels. By using these commands or operating independently, the crew visually locates the target, determines who it belongs to, and, if it turns out to be an enemy attack aircraft, the PZRK crew launches a missile after determining its range and receiving a command to destroy it.

The way in which the PZRK crews deliver their fire is regulated by constantly updated instructions on the conduct of combat operations. For example, against piston engine aircraft and helicopters, a "look-shoot-look" firing method is used; but for a single jet plane a "shoot-shoot-look-shoot" approach is used. In the latter case, firing on the target is done simultaneously by the crew commander and the gunner. When there are a large number of targets present, the crew intercepts the most dangerous targets using a "shoot-new target-shoot" approach. With this method, the functions of the PZRK crew members are determined in the following manner: the commander fires on the support aircraft or those aircraft to the left of the target and the gunner selects for himself the lead plane (helicopter) or those aircraft to the extreme right. Firing continues until the entire ammunition load accompanying the crew is used up. If amunition supply is difficult, a more economical method of firing is selected or the range at which firing is commenced is reduced. Fire coordination between PZRK crews is effected according to previously-agreed upon operations to select targets and establish area of fire.

The launching of missiles during nighttime conditions or in daylight gives away one's position (at night one can see the flames from the engine's combustion and during the day, the the missile's powder trail), which raises the possibility of the firing position being detected. So, in order to increase the crew's survivability, it is recommended that firing be conducted on the move or during brief halts, and that the firing positions be changed after every missile launch.

American military specialists believe that maximum effectiveness in the air defense of troops is achieved where they are protected by combined air defense subunits. So, in order to protect a battalion tactical group, it is useful to assign an VULCAN ZRK platoon (in the future, a SERGEANT YORK ZRK platoon) and a section of STINGER PZRK (five crews) to it. On the offense, ZRKs are assigned to companies in the first echelon (two per company) but the task of covering the companies of the second echelon, the command post, and rear facilities will go to the crews of portable air defense missile systems. On the defense, the ZRKs are centralized, but the PZRK crews are distributed among the companies (one for each company) who are intended to cover the command post and the group's rear. PZRK sections made up of three crews each (one per battery) are used to protect artillery battalions. The foreign press emphasizes that it is not good to deploy various types of air defense assets to a single position since this decreases the effectiveness of the air defenses. It is considered that the firing position of the PZRK crews should be no less than 1,500-2,000 meters away from the ZRKs on the path of self-propelled air defense artillery mounts.

On the offense, it is recommended that PZRK crews deploy directly within the combat formations of the subunits they are protecting. When there is no threat of air strikes, they are shifted from one perimeter to the other in preparation to repulse sorties. In the event the enemy should appear from the air, troop cover will materialize through a support fire method, and firing will be conducted on the move or during brief halts, but when subunits are forcibly delayed--from temporary firing positions. When repositioning crews, terrain conditions and the situation and nature of the combat operations are taken under consideration. Likewise, the crews are deployed so that they are not affected by enemy ground forces' fire. Once operations shift into the pursuit, the crews are put into the columns of the subunits they are protecting and they accompany the subunits.

In the place where the troops form up, the PZRK are distributed so as to protect the subunits from surprise enemy air strikes from any direction and to allow subunits to fall quickly into columns once they are underway. To do this, temporary firing positions are set up a distance of 400-600 meters away from the subunits being protected along the axis of a probable enemy sortie.

While moving about with the subunits being protected, the crews remain under the section commander's control. Considering their vulnerability on the battlefield, the commander may decide to take measures to increase their safety. Thus, they can follow behind the subunits they are covering at distances which can reliably assure that they are covered.

If the subunits being covered in the course of the battle are to force water obstacles, the PZRK crews cross over with the subunits, being sure that the details with the other air defenses is constantly covering them from enemy air strikes in the section being forced. After the opposite shore is captured, a portion of the crews crosses over to the other side, sets up firing positions, and, if time is available, digs in. If the PZRK crews are not tasked with constantly covering the region of the forced river crossing, then, once the subunits being covered have made the crossing, the crews may continue accompanying them.

On the defense, PZRK crews are distributed over the terrain so as to be able to repulse enemy air sorties along any axis and to create a solid zone of cover. If the combat formation of the subunit and the number of crews covering it permit, the air defenses are so organized that the mutual support of neighboring crews is assured. In the opinion of American military experts, this is achieved by stationing the crews 2,000-3,000 meters from one another. Furthermore, the intervals and the distance between crews, as well as the distance from the FEBA and the units being covered, will always be determined by the particular conditions of the combat situation.

The firing positions for crews are selected in accordance with the principle of creating active opposition to enemy aviation. As reported in the foreign press, the inability of the portable RED EYE to fire at air targets head-on, forced the commanders of the air defense organization defending the troops to send a portion of the PZRK crews beyond the forward defense perimeter, assuring that they could shoot and increase the probability of hitting enemy planes and helicopters before they could inflict strikes upon the ground

forces. Hence, the crews were constantly under threat of being hit by enemy ground forces or having to engage his weaponry. The fire positions of STINGER PZRK crews, which are capable of striking air targets head-on, as a rule, are deployed within the combat formations they are covering or behind them. It is recommended that positions be selected such that low-flying targets can be visually identified at ranges of no less than 6 km while providing the necessary arcs of fire on probable enemy attack axes and at the maximum effective firing range. It is considered best to place firing positions on high ground, taking into consideration that there will be minimal impact from the sun's direct or reflected rays. PZRK crews are deployed in positions in the open by taking advantage of the sheltering properties of the terrain or in gun pits. Besides the major positions, several reserve firing positions are also prepared and carefully camouflaged. For safety's sake, the missile launch area should be evacuated of personnel (for a radius of 50 meters) and equipment (up to 5 meters). Slit trenches and shelters are dug for the crews' personnel and vehicles. A warning network is set up to receive data on the air situation, and, if time is available, line communications are laid.

The PZRK crews in firing positions are ready to execute swiftly a maneuver to the subunits' deployment perimeter for counterattack. Depending upon the decision of the unit's senior officer, a portion of the PZRK crews can operate within ambush parties or "roaming" subunits. In this instance, the crew's area of combat operations and the traffic routes are assigned so as to be able to cover the probable axes of a concealed approach of air targets or of enemy assault landing groups in helicopters.

On the march, according to American military specialists, particularly within the combat zone, the PZRK crews are tasked with keeping formations of units and subunits on the march from getting hit by low altitude air strikes.

Crews can be deployed from within troop columns, accompanying them in readiness to repulse sorties or can be distributed about in firing positions along the traffic route in places most vulnerable to enemy air strikes (water crossings, road intersections, defiles, refueling sites, halts, etc.). The air defense chief of the section being covered selects a variant for using PZRK crews based on an analysis of the air situation, the quantity of available air defense assets, and their firing capabilities, as well as the kind of traffic route that lies ahead.

When distributing the crews in the march columns, one takes the length of the column and the number of allocated covering crews into account. The foreign military press notes that they are optimally deployed at the head and tail of the column. If there are still crews left over, they are distributed evenly along the entire column (at a distance of up to 3,000 meters from one another), calculated in such a way as to assure fire support and to create zones that completely cover the column. In the case when only one PZRK crew is allocated to cover the march column, it is used in the following manner: the commander is deployed at the head of the column and the gunner at the rear. When crews are available for flank protections, it is advantageous if they also are included in the column defenses.

When PZRK crews can be moved forward into firing positions along the traffic route ahead of time, they do so in accordance with the section commander's decision. Positions are selected after a preliminary study of the march route and a determination of those areas which would be most susceptible to enemy

air strikes. After the column gets underway, the PZRK crew falls into the march formation and directly protects the subunits on the march.

In plans to improve troop air defenses further, a great deal of attention is being paid to portable air defense missile systems. The commanders of the U.S. ground forces, judging from reports in the foreign military press, are anticipating arming combat units and corps-level rear services with them. Furthermore, the STINGER PZRK will also be put into service in air defense brigades and in detached ZRK (PATRIOT, IMPROVED HAWK) battalions. It is planned that the number of PZRK crews will increase in the new heavy divisions, but the air defenses of light formations will contain only PZRKs.

28 Work is underway on creating a follow-on generation of PZRK. A new portable SABRE PZRK is being developed intensively within the framework of this program. Besides destroying low and very low altitude air targets, it will permit the destruction of ground armored targets. In the future, based on reports from the foreign press, it is envisioned that firing crews will be outfitted with their own means to do reconnaissance on low flying enemy aircraft, assuring their detection at ranges up to 20 km.

On the whole, American military specialists believe that the availability of a large number of portable air defense missile systems in units and subunits, the timely warning of their crews of an air anemy, and their control during battle will assure an effective air defense for ground forces units and formations.

1. Later on in the text data on the organization of STINGER PZRK and the numbers of them in future divisions of the U. S. ground forces (Division-86) are presented.--Editor.)

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CSO: 1801/87

U.S. ARMY THEATER MEDICAL ORGANIZATION DISCUSSED

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 85 (Signed to press 11 Nov 85) pp 36-40

[Article by Lt Col V. Vladimirov; "Organization of Medical Support for the U.S. Army in the Theater of Operations"]

[Text] The leadership of the U.S. armed forces believes that under contemporary battlefield conditions, forces, especially ground forces, will suffer significant casualties. In this regard it devotes the very closest attention to the organization and long-term improvement of the medical support system for the ground forces both in the United States and in overseas theaters (especially Europe), believing that the combat readiness and morale of the troops will largely depend on its (the medical system's) readiness and effectiveness.

In U.S. Army manuals and regulations emphasis is given to the point that the basic mission of medical units, formations, and institutions is the administering of timely qualified medical aid through a number of measures, including rendering immediate aid to wounded and injured, evacuating them from the battlefield to the appropriate medical facilities, hospitalization and treatment.

Medical support of the theater army is organized in parallel with the organization of forces as follows (Fig. 1): in the communications zone (COMMZ) and the combat zone (corps, divisions, units and subunits).

Responsibility for the organization of medical support for ground forces in the COMMZ lies with the medical command commander.

The organizational structure and composition of the command is not fixed and may be varied depending on the size and composition of the supported forces, the nature of combat activity, the physical geographic conditions in the combat theater, and many other factors which influence the effectiveness of troop medical support. One of the possible variations of the organization of the theater medical command is shown in Fig. 2.

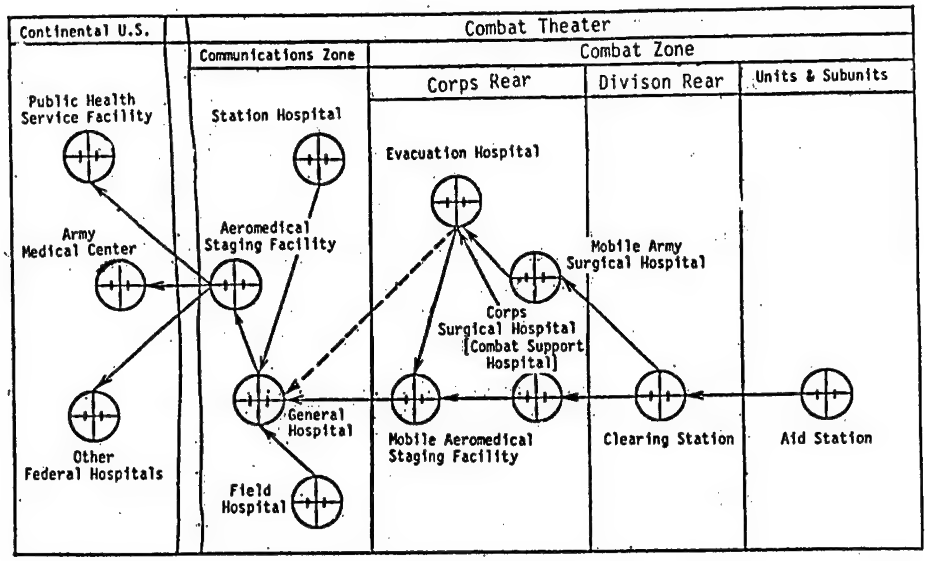

Figure 1. Flowchart of U.S. Army Theater Medical Support

The medical command has responsibility for the following missions:

Render immediate aid; evacuate wounded, sick and injured from the combat zone; triage; administer qualified surgical care and treatment followed by a return to duty or evacuation to CONUS;

-- Reinforce, in case of necessity, the medical subunits of the combat units and formations;

-- Support the state of health and organization of the medical service of the army personnel in theater;

-- Coordinate activities of the medical service units in the communications and combat zones;

-- Prepare and present to the highest medical authorities current information on the status of medical support of the forces;

-- Command of the medical laboratories, dental, and veterinary services;

-- Sanitation inspection of the areas occupied by forces and timely reporting to the commander and staff on the necessity to relocate in case of a threat of an outbreak of an epidemic.

Medical support of forces in the COMMZ is carried out on the principle of service by the medical subunits within consolidated areas. This support provides sanitation supervision, collection, triage, and evacuation of wounded, sick and injured.

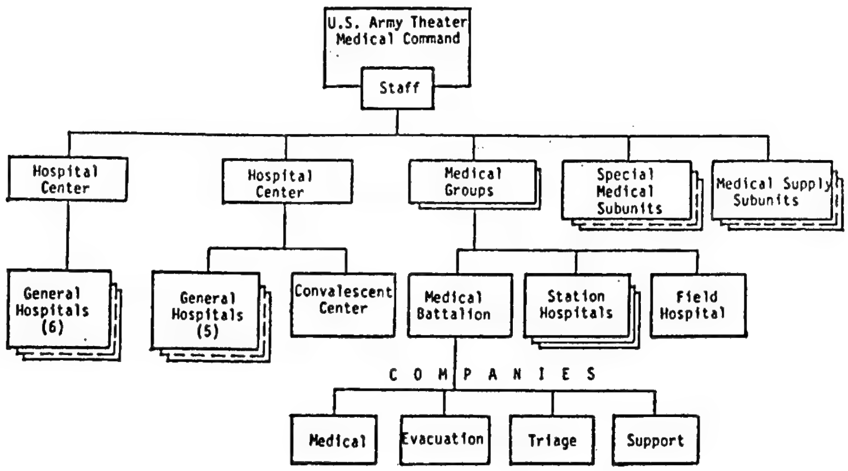

Figure 2. Organization of the U.S. Army Theater Medical Command Structure (Example)

In accordance with U.S. Army manuals for organizing medical support, the medical command includes rear and forward medical groups.

The rear medical group organizes medical support for forces in the COOMZ where it deploys 1,000-bed general hospitals, station hospitals of 200, 300 or 500 beds, field hospitals, each of which is capable of deploying as one 400-bed unit or three 100-bed units.

All-around qualified medical treatment of the wounded, sick and injured who are sent from the medical facilities deployed in the combat and communication zones is accomplished in the general hospitals. Transportable wounded, sick and injured who require specialized and long-term treatment (over 15 days) are sent to mobile aeromedical staging facilities from which they are evacuated to the U.S. on air transports.

Station hospitals deployed in the COMMZ are designed to receive and treat wounded, sick and injured from the forces permanently located in that zone. In especially difficult conditions or due to a lack of room in hospitals, patients are sent to general hospitals where they undergo treatment or are evacuated to CONUS.

Personnel of formations and units temporarily stationed in the COMMZ receive qualified medical assistance in field hospitals.

The tasks of collecting, triage, and dispatching of wounded, sick and injured to treatment facilities, all other types of medical service, and supply of hospitals with medical materials are the responsibility of the subunits in the medical groups and other specialized subunits in the medical command.

Forward medical groups carry out medical support missions for forces in the rear area of the combat zone. Each group deploys several evacuation hospitals, mobile surgical hospitals and mobile aeromedical staging facilities. Group subunits closely coordinate with combat formation and unit medical subunits.

Corps medical support includes a system of facilities for rendering first aid to victims; the evacuation of wounded, sick and injured from corps and division subunits to appropriate treatment facilities, their triage, hospitalization and treatment, dental care; laboratories and other types of medical support of the forces; as well as the supply of medical stores, medications, chemicals, instruments and equipment to medical facilities.

All forces and resources designated for fulfilling the above-mentioned missions belong to a medical brigade or medical group, depending on the composition of the corps. Medical brigades are formed in corps containing three or more divisions.

Overall leadership of the subunits and facilities of the brigade is carried out by its commander, who simultaneously is the chief of medical service (chief surgeon) of the corps.

The medical brigade (Fig. 3), like the medical command, does not have a permanent complement. Its basic organization is the medical group (the number of these per brigade will depend on the combat organization of the corps). It may contain several medical detachments of various designations, evacuation, mobile army and corps surgical hospitals, medical battalions (according to the number of divisions in the corps). [Trans. note: the author has mistaken CSH (Combat Support Hospital) for Corps Surgical Hospital].

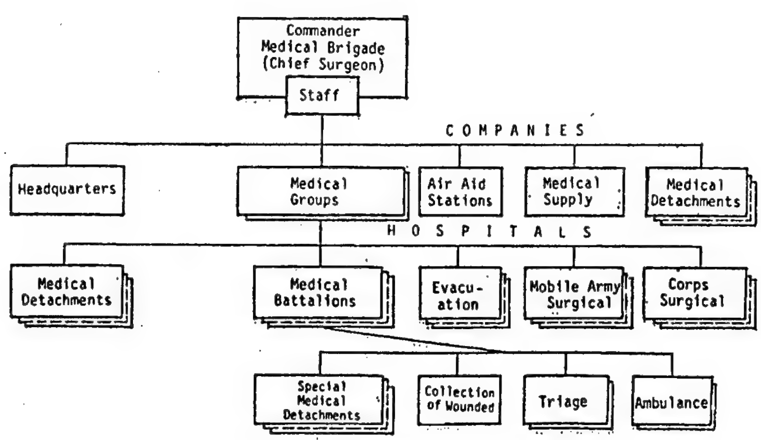

Figure 3. Organization of the Corps Medical Brigade (Example)

Medical detachments are subunits designated to fulfill missions of evacuation of the wounded, sick, and injured, ambulance, dispensary, dental, and other types of medical service of the forces in the medical group's region of responsibility.

The number and type of hospitals, the deployed forces and means of the medical group in the corps rear, according to U.S. Army manuals, are based on the number of divisions in the corps. For each division there are in the corps rear one corps surgical [combat support] hospital (200-bed) and two evacuation hospitals (400-bed). Additionally, in the zone of the corps there may be deployed a field hospital, assigned from the theater ground forces medical command, which is designated for the treatment of personnel temporarily located in the corps rear, prisoners of war and displaced persons.

Evacuation of the wounded, sick, and injured from the division evacuation points to hospitals in the corps rear is carried out, as a rule, by corps air and ground assets, and from corps hospitals to hospitals in the communications zone by U.S. Air Force medivac and theater ground forces medical command transport.

The medical battalions are designated for collection, triage, and evacuation of the wounded, sick, and injured to various treatment facilities. Each battalion may have from three to seven companies of various types and specialized medical detachments. Medical battalions are deployed and carry out their missions both in the corps rear and in the areas occupied by first echelon divisions.

The basic missions of the subunits deployed in the corps rear area are medical support of the forces deployed in that area, as well as aiding battalion subunits in carrying out their mission in the area of responsibility of a first echelon division.

Medical subunits moved up to the area occupied by a first echelon division, as a rule, carry out evacuation and temporary hospitalization of the wounded, sick and injured. Medical support in a division involves collection, triage, treatment and returning to duty the wounded, sick and injured from the division, as well as units and subunits located in its area of responsibility. This medical support is organized at all levels from divisional units and subunits to platoons, inclusively.

The basis of medical support of combat platoons is rendering pre-physician aid upon wounding or injury with forces of the regular company and stations. Delivery of wounded and stricken to battalion aid stations and, subsequently, to division evacuation stations, is accomplished by litters, ambulances and helicopters.

In all combat and support battalions of the division (excluding signal, engineer, cavalry and EW (Electronic Warfare) battalions, chemical and military police companies) have organic medical platoons which establish battalion aid stations. Also, aid stations are set up at the division headquarters and headquarters company.

The organic battalion medical platoon has a command group and three sections: aidmen, evacuation, and service stations. The platoon command located, as a rule, in the area of the battalion aid station, is designed for guiding the work of the subordinate units of the medical platoon. The personnel of the medic section are divided among the subunits of the battalion. The evacuation section carries out the delivery of wounded and injured from the place where they are acquired to the battalion aid station. Here the personnel of the service section examine and sort wounded and sick, and prepare them for evacuation to the rear, which is accomplished both by ground and by air medivac.

Missions of medical support of brigades and divisional units and subunits are assigned to the medical battalion from the division support command[1], which includes a headquarters and service company, medical companies (according to the number of brigades in the division). Each company consists of a headquarters and two platoons--and evacuation and ambulance.

The evacuation platoon is designed to operate the division evacuation station, which is designed for the simultaneous reception of 40 wounded and sick who are given required medical attention and then prepared for evacuation to the corps rear or communications zone. Lightly wounded are returned to duty after unprotracted treatment at the evacuation station. Besides treatment at the evacuation station, division personnel receive dental and other types of medical aid, Evacuation of the wounded and injured to corps treatment facilities and hospitals in the COMMZ is accomplished by medical personnel of the corps rear area command. The ambulance platoon is designated to deliver wounded and injured from battalion aid stations to division evacuation stations.

Supplying subunits and medical support facilities with medicines, medical supplies, equipment, etc., is the responsibility of the corresponding corps medical service organs. Repair of medical equipment and instruments, with which division treatment subunits and facilities are equipped, is carried out by the repair section of the division medical battalion, while its own equipment is repaired in the repair shop of the corps medical brigade.

Thus, the U.S. Army deploys, in the theater of operations, a well developed system of medical support at all levels--from the COMMZ to combat subunits of the division first echelon. The American leadership believes that the existing system is capable of reliability accomplishing evacuation of the wounded, sick and injured at various levels and their treatment in a short time in treatment facilities deployed in the theater in wartime.

1. In the future division, the division support command is planned to have a medical battalion, while the battalions in the support of brigades would have three medical companies.

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CSO: 1801/87

USE OF FOAM FOR CAMOUFLAGE DESCRIBED

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 85 (Signed to press 11 Nov 85) p 40

[Article by Col V. Elin; "Camouflage Using Foam"]

[Text] Tactical camouflage, as before, retains its significance as a type of engineer support for combat operations and routine troop activities. Therefore, abroad a search is being conducted for new means and ways for camouflaging military targets from optical and infrared reconnaissance resources and [from] enemy observation.

The Western press reports that a froth-forming mixture has been developed in Sweden which, in conjunction with other, traditional methods of concealing targets, can be employed as a camouflaging agent.

The main camouflaging characteristic of chemical foam is that it distorts the typical infrared signature of the shapes of military equipment. Foam, being applied to the target being concealed, takes on its temperature and, as a result, the infrared detectors cannot "discern" it. Foreign specialists believe that chemical foam almost completely precludes the recognition of the shapes of military equipment by optical and electro-optical instruments and that eventually it will hamper their detection.

The froth-forming mixture is applied to the surface of a target which is located in natural cover or under standard camouflage netting, using a set of appropriate modular devices. The foam which is produced adheres very well to any surface, and is weather resistant and can be tinted to various colors depending upon the surrounding environment.

9355
CSO: 1801/87

NATO AIRBORNE EARLY WARNING, CONTROL SYSTEMS

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 85 (Signed to press 11 Nov 85) pp 41-49

[Article by Col M. Makarov; "The Airborne Early Warning and Control System of NATO's Air Forces"]

[Text] In the aggressive North Atlantic Alliance's militaristic preparations, a system for the control of troops and weapons occupies a special position, and its constant perfection is one of the leading directions in the sphere of military construction. With this, the paramount importance at the present stage of development of the bloc's joint armed forces is attached to the following questions: the increase in the combat readiness of such systems; the reduction in the degree of control post vulnerability and communication systems reliability and protection; automation of the control processesfor the representation of the situation in the air, on the ground, and at sea in real time; the unification of control systems, reconnaissance and the means of destruction into a single complex. According to announcements of NATO specialists, an Airborne Early Warning (DRLO) and control system should answer these requirements to a great extent.

NATO military experts justify the necessity to create such a system by the fact that the fixed radars of control posts and radar sites of NATO's Allied Air Defense System in Europe are very vulnerable and have insufficient range to detect low altitude targets, especially in mountainous regions. This exerts considerable influence on the timeliness of warning regarding the air enemy, on the control organs and posts, and also for active air defense forces, bringing them to readiness for the intercept or firing on targets. In addition, the NATO command considers that the character of combat operations under contemporary conditions and in the future, will assume a growing complexity in the air situation, their high dynamics and the intensive employment of electronic warfare (EW) systems. All this increases the demands for continuous control of the air force. With the complete entry into service of the DRLO and Control System (1987), the NATO command plans to expand significantly the capabilities of the already-existing ground-based command control system for tactical aviation and the air defense forces and equipment and to increase them based on the employment of the E-3A aircraft and the NIMROD AEW.3 as airborne radar and command-and-control posts.

According to foreign press reports, the DRLO and Control system of NATO air forces is intended for the timely detection and identification of air and surface targets, guiding their aircraft to them and the delivery of information on the situation to ground, air and shipborne command posts, and also for the command-and-control of the combat operations of tactical air crews during their delivery of strikes on assigned targets, and for the execution of other missions. Its principal element is the DRLO and control of NATO air forces (the NATO AWACS Command). In addition, it includes the subsystem NAEGIS (a network of ground-based command posts and radar sites).

THE NATO AWACS COMMAND. Organizationally, the personnel and equipment of the DRLO and control of bloc air forces are combined into the independent special NAEWFC command (NATO Airborne Early Warning Force Command). The preliminary measures for creating it were started in 1980. As a new operational organ of the bloc, it is directly subordinate to the supreme commander of NATO's Allied Armed Forces in Europe.

The command has been operational since June, 1982. A general officer heads it; generals of the air forces of the U.S. and the FRG are assigned in turn to this position for three-year tours (since June, 1984, it has been headed by West German General K. Rimmek). The commander carries out the operational leadership of all its assigned forces and bears the responsibility for organizing their combat training and equipment, and also for the timely support of the strategic commands of NATO's Allied Air Forces in Europe, in the Atlantic and in the Straits of La Manche zone regarding information on the air situation in the European theater of war, and for the organization of control of the air forces during combat operations.

The execution of the following principal missions fall to the command: provide reliable long-range radar detection of air targets and the timely transmission of information on them to ground-based control organs of the NATO Joint Air Defense System in Europe; control part of the air defense fighter and tactical aviation forces during combat operations; monitor primary routes of the air and naval transport of troops and combat equipment from the U.S. to Europe, and also within the theater, and train flight and technical personnel.

The command includes a headquarters, an operational airbase, an independent English DRLO squadron. In addition, four forward airbases are operationally subordinate to it (the organization schematic of the command is shown in Fig. 1) .

The command headquarters is located in the small town of Mezer (Belgium) near the headquarters and command post of the supreme high commander of NATO's Allied Air Forces in Europe, located in Kasto. It consists of six sections and secretariats. The headquarters works out the plans for the operational employment of the forces and resources; monitors the state of combat readiness of the subordinate units and subunits; organizes their material-technical support and the cooperation with the commands of the bloc's Allied Air Forces in the theaters of military operations, and with control posts and organs of NATO's Allied Air Defense System in Europe. It numbers around 80 officers and non-commissioned officers.

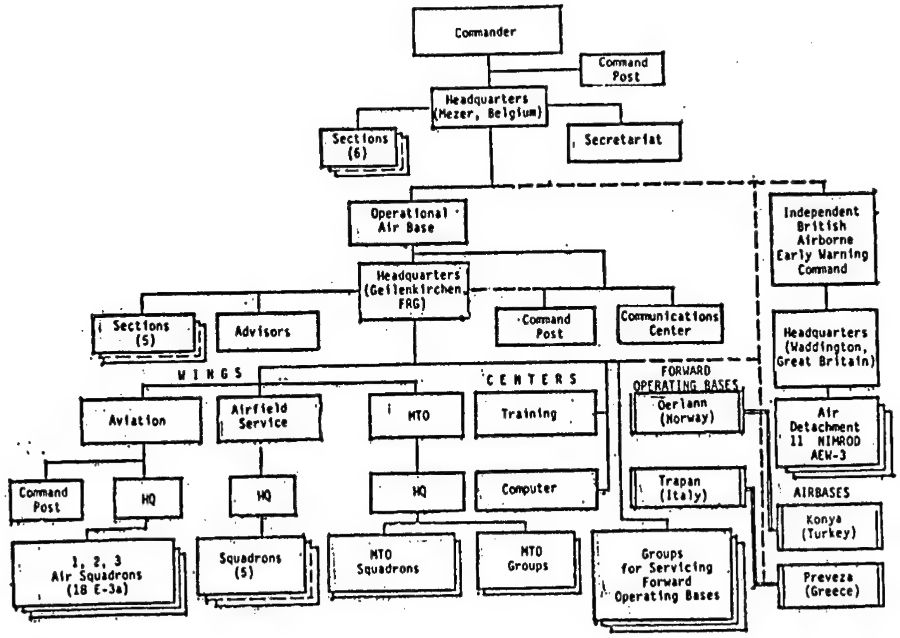

Figure 1. NATO AWACS Command Organization Diagram

The operational airbase (located at Geilenkirchen Airbase, FRG) is an independent troop unit of NATO. As a multinational troop unit, in a legal sense it equates to the bloc's military headquarters. For customs and a number of other questions, the general provisions in operating documents, concerning the deployment and activities of NATO armed forces in Europe, and also separate requirements for the service personnel of the bloc's headquarters, located on the territory of the FRG, apply to its personnel.

In connection with the absence of individual NATO manuals and instructions on the engineer-technical service and for providing security of E-3A aircraft flights, American documents are taken as the basis by which the personel of the 52nd Air Division of the U.S. Air Forces Tactical Air Command (equipped with E-3A and B aircraft) are guided as well as the West German regulation ZDV 57-1. At the same time, the DRLO Command of NATO Air Forces worked out new manuals for the combat employment of E-3A aircraft, the protection of Geilenkirchen Airbase, and the support of order and security at it.

The unit includes a headquarters, three wings (aircraft, airfield service and material-technical support), a command post, a communications center, training and computer centers, and also support groups for forward operating base servicing. In all, it numbers more than 2,000 military and civilian specialists. U.S. and FGR Air Force Generals (since 1984--American General K. Cox) assume the position of unit commander in turn for three year tours.

The headquarters of the operational airbase was created based on the organizational structure and the work experience of the headquarters of the aviation wings, groups and squadrons of the air forces of the U.S., Great

Britain, and the FRG. It includes five sections: operations, cadre, administration, finance, and security.

The wing commanders and chiefs of the centers, included in the operational airbase, are simultaneously deputy unit commanders for appropriate matters, (operations, airfield-technical service, material-technical support training and programming).

The aircraft wing organizationally consists of a headquarters, three E-3A aircraft squadrons and a command post. The headquarters includes sections for combat training and planning, reconnaissance, flight statistics and standardization, and also a search and rescue service and a communications group, which maintains "ground to aircraft" covered communications channels.

Delivery of E-3A aircraft to the air wing began in February, 1982. In June, 1985, the equipping of all three air squadrons with them (six aircraft in each) was completed. According to foreign press reports, it is planned to simultaneously base not more than 12 E-3A aircraft at Geilenkirchen, and the remaining will be located and serviced at forward operating bases. An officer of the Canadian Air Force of the rank of colonel is permanently appointed as the commander of the air wing.

According to its structure and purpose, the airfield service wing has a great deal in common with an airfield service group of the FRG Air Force. However, it differs from the latter by a broadened composition. It includes five squadrons; flight support, transport, security and auxiliary and medical services. In addition, a geophysical information post which issues weather forecasts to the E-3A aircraft along all flight routes is subordinated to the flight support squadron, and a joint company of military police, including several platoons formed from representative NATO countries is subordinated to the security wing. The wing commander is a colonel of the FRG Air Force.

The material-technical support wing consists of a headquarters, two squadrons and three material-technical support groups. It is intended for the technical servicing and repair of E-3A aircraft and ground equipment, and also for the supply of reserve units. The work experience of technical groups of aviation squadrons of the FRG Air Force, which employ the principle of centralized servicing of aviation equipment and the supply of technical subunits, serves as the basis for the wing's functioning.

The servicing and repair of E-3A aircraft is carried out in accordance with U.S. Air Force manuals and instructions. Rear support and technical servicing, not concerned with the onboard systems of the E-3A aircraft, are conducted by specialists of the air forces of those countries on whose territory these aircraft are based. Their major overhauls are intended to be completed at U.S. aviation factories and several West European NATO countries. In addition, as the foreign press reported, the American firm Boeing provided more than 50 specialists to service the E-3A aircraft and their on-board systems at Geilenkirchen during the periods for the conduct of operartional chacks or repair.

The training center organizes and conducts the training of flight crews, aviation-technical personnel and operators of the on-board radioelectronic systems who are sent from the air forces of the NATO countries for instruction regarding the combat employment and operation of the E-3A aircraft. In addition, programming specialists are retrained here. As a rule, civilian personnel who have completed training are sent to the operational air base's computer center. The complete training course (in English) lasts 1.5 years. The center has available trainers which simulate the flight of the E-3A aircraft and the operation of its on-board systems. During the training, flights in the E-3A aircraft are organized so that crews acquire and consolidate firm skills in patrol techniques, and the operators in the operations of the on-board systems and the detection and identification of air and ground targets, and the guidance of air defense tactical fighters to them. An Italian Air Force colonel is permanently designated the center chief, and the officers of the Danish and Portuguese Air Forces rotate as the deputy commander.

The computer center works out and prepares the primary and reserve programs for the operational employment of E-3A aircraft in each specific TVD with their subsequent input into the on-board computer. Simultaneously, the accumulation and processing of reconnaissance information, received during combat patrol on an established route or in specific regions, and also the input of new information into primary programs, is carried out at the center. In addition, complex training programs and scenarios, utilized in the training center are worked out at it and the collection, accumulation and analyses of information necessary for the planning and perfection of the combat employment of the forces and equipment of the NATO AWACS command is accomplished. A Norwegian Air Force colonel is permanently appointed as computer center commander.

The basing of the aircraft of the DRLO and control system of NATO Air Forces is currently carried out at one main operating base (MOB), Geilenkirchen, and four forward operating bases (FOB). The main operating base of Waddington (Great Britain) will become part of the basing system after the deployment and transfer of the independent squadron of English NIMROD AEW-3 aircraft to the NATO command.

As noted in the foreign press, flight, aviation-technical, rear and other units and subunits of the command are located at the main operating bases.

Geilenkirchen airbase (northern Aachen, FRG) was constructed after the Second World War and up until 1968, was utilized by the English Air Force. Subsequently, it was transferred to the FRG Air Force, and in 1980, to NATO's Allied Armed Forces in Europe for the relocation of units and subunits of the NATO AWACS command. In 1980-1982 a new runway (3,400 x 50 m) was constructed parallel to the old (2,400 m in length), and also a modern command post and storehouses were erected, and service, billeting and technical buildings were reconstructed.

Waddington Airbase is located 5 km south of Lincoln. The length of the main hard surface runway is more than 2,700 m. Its radio navigation and lighting equipment supports all-weather day and night flights. Presently, the 8th DRLO

squadron, equipped with the older SHACKELTON AEW-2 aircraft, is located there. Plans are to re-equip it with the NIMROD AEW-3 aircraft by 1987.

The forward airbases Orlann (Norway), Trapani (Italy), Preveza (Greece) and Konya (Turkey), in contrast to the main operating base (Geilenkirchen) remain subordinated to the commands of the national armed forces. They are intended primarily for the reception of E-3A aircraft after they conduct combat watch on the flanks of the bloc, for their refueling, exchange of crews, the carrying out of interflight servicing and light repair (except for the on-board radioelectronic equipment of the AWACS system). Western experts consider that any military and civilian airfield, with a hard surface runway having dimensions and strength suitable for landing Boeing 707 passenger and cargo transports (on which the E-3A was based) can be used as forward operating airbases for the E-3A aircraft. The NATO AWACS command formed special groups for servicing the E-3A aircraft at forward airbases. Currently, the forward airbases of Orlann and Konya are utilized for NATO purposes completely.

Orlann Airbase is located 50 km northwest of Tronkim (southern Norway). It is frequently designated as a Forward Operating Local (FOL) in the Western press. According to the Norwegian press, by the end of 1983, the main runway hasd been lengthened and reinforced, the reserve landing strip and taxi way re-equipped, a modern landing system installed, and a hanger for the E-3A aircraft constructed.

Konya Airbase is located in the southern part of Turkey, 13 km northeast of the city of Konya. The main runway is 3,400 x 43 m. A taxi way (3,400 x 23 m) runs parallel to it. According to foreign press reports, work has been completed at it on runway reconstruction in order to support the arrival of E-3A aircraft, the landing system has been modernized, buildings for flight and technical personnel have been constructed, and a new hardstand has been equipped. The airbase officialy opened for the arrival of the E-3A aircraft in October, 1983. More than 50 Turkish military personnel, who completed the training course at Geilenkirchen, are the primary service group for the E-3A aircraft at Konya.

Tarani and Preveza airbases are located near cities of the same names. It was planned to complete the work on their reconstruction and to begin periodic basing of 1-2 E-3A aircraft at each of them in 1985-1986.

THE NAEGIS SUBSYSTEM. In accordance with the program to deploy the AWACS system in Europe, a number of command and control posts and radar sites were combined into a special NAEGIS subsystem in 1979--(NATO Airborne Early Warning Ground Environment Integration Segment). It includes zonal, regional, and sector operational centers; control and warning centers and posts; radar sites of the bloc's Allied Air Defense System; and also command posts and communications centers are components of the NATO Airborne Early Warning Command. The modernization of more than 40 ground centers and posts, equipped with the NAEGIS automated control system (ASU) (this system supports the automation of command and control processes of NATO's Joint Air Defense System in Europe), is being accomplished within the limits of the subsystem. It was noted in the Western press that its main goal is to equip these units with a

device to interface with AWACS aircraft, modern computers, new radars, etc. Terminals of the American Joint Tactical Information Distribution System (JTIDS) form the basis of the interface system.

As the foreign press reported, by the beginning of 1984, six control and warning centers had been modernized on the territories of Denmark and the FRG, and by the end of 1985, work is expected to be completed on all planned units, located on the territories of other NATO countries: Norway (four), Great Britain (four, of which one is on the Shetland and Faeroes Islands), the Netherlands (one), Belgium (one), Italy (eight, including two on Sicily), Greece (three, of them one on the Island of Crete), and Turkey (six). Thirty-five control posts and radar sites are considered main ones and will be modernized completely, and six are intermediate ones (for economic reasons, it is not envisaged to install JTIDS system terminals in them). Information, received from the E-3A at the primary control posts will be transmitted to intermediate posts over LINK-1 communication circuits.

Identical equipment for processing information received from the air forces' DRLO and control aircraft is being installed in all NAEGIS subsystem control posts. It includes new H5118M computers, which have double the operational speed of the H3118M computer, which has been utilizedby NATO since the 60s. The additional computer power is planned to be used primarily for processing information on low-flying targets detected by the E-3A and NIMROD AEW-3 DRLO and control aircraft.

THE COMBAT EMPLOYMENT OF THE AIRBORNE WARNING AND CONTROL AIRCRAFT (their tactical-technical characteristics are shown in the table).

TACTICAL - TECHNICAL CHARACTERISTICS OF E-3A AND NIMROD AEW-3 AIRCRAFT

MAIN CHARACTERISTICS	E3A	NIMROD AEW-3
Crew	17	10
Maximum take-off weight, kg	147 400	87 000
Take-off distance, m	3054	1460
Take-off distance, m		
Maximum	850	800
Cruise	740	700
Service ceiling, m	13 400	12 000
Duration of a patrol at a distance of 1,300 km from base		
Without in-flight refueling	8—10	6—7
With in-flight refueling	up to 24	
Target detection range, km		
At high altitude	over 600	
At low altitude	up to 400	
Number of engines and thrust, kg	4×9525	4×5508
Aircraft dimensions, m		
Length	46.61	41.97
Height	12.73	10.67
Wing span	44.42	35.08

Radars with an IFF system, computers, and a communications system comprise the E-3As on-board equipment. The first can work in a Doppler and pulse mode (in one or in both). The Doppler mode is used for detecting air targets at low and medium altitudes at distances up to 400 km, and the pulse mode to detect targets at medium and high altitudes at distances up to 600 km and beyond, and also to detect surface targets. According to foreign press reports, in a low sea state, the radar is able to detect even wooden vessels having a length of 15 m and 8-m plastic boats. Destroyer-class surface ships can be

detected when the height of the waves is up to 4 meters. For simultaneously tracking the situation in the air and on the ground, a combination (pulse-Doppler) operating mode is used.

The presence on the E-3A of a state-of-the-art computer and other automated systems permit the rapid selection of the most important sectors for controlling the air space, of optimum radar operational modes and rapidly changing them. Information (course, speed, and accessories etc.) received by the computer from the radar is converted to digital form, compared with information existing in the memory, processed in table form, and transmitted to sector operational centers; control, and warning centers (TsUO); the command posts of fighter wings and antiaircraft missile batteries of NATO's allied air defense system in Europe; TsUO of the tactical aviation control subsystem; the command posts of tactical fighter wings, and formations of the ground troops, aircraft carriers, and other DRLO aircraft, located in neighboring patrol areas.

To a great extent, the E-3A aircraft is set up to conduct radar reconnaissance in support of offensive operations, during which strike aviation weapon systems are being employed. The centralized control of large forces of strike aviation, operating over vast regions and also of detached groups of combat aircraft deep in enemy territory can be accomplished from the E-3A aircraft under combat conditions. In this case, its crew executes the following missions: guide fighter bombers and ground-attack aircraft to fixed targets detected beforehand (airfields, bridges, warehouses); warn of the approach of enemy aircraft and control the combat of cover fighters; insure the operational security of aviation strike groups by issuing information to them on the optimum routes to avoid the operational zones of enemy air defense systems and to help crews returning from combat missions until they reach lines where they can establish continuous communication with ground-based command posts.

The E-3A's communication system includes more than 15 radios, operating on the decimeter, meter, short wave and ultra short wave frequency bands, and also units for the automatic transmission of JTIDS system information and commands.

As the foreign press reports, the E-3A aircraft's multinational crew includes: a flight group (commander, co-pilot, navigator, and flight engineer), nine operators (guidance and computer) and four radioelectronic systems technical specialists. Usually one crew completes a flight. An additional crew (any group of separate specialists) for the replacement of the primary crew is carried on board during a long combat patrol (with in-flight refueling) or for training purposes.

In the future, it is planned to equip E-3A aircraft with EW systems, "air-to-air missiles" and equipment for detecting small mobile ground targets.

The English NIMROD AEW-3 aircraft was developed on the basis of the NIMROD MR-1 naval reconnaissance aircraft. According to foreign press evidence, the construction of the DRLO and control aircraft began at the end of the 1970s and, since 1982, they were to have been delivered to the eight squadrons mentioned above. However, because of incompatibilities of the tactical-

technical characteristics of the on-board radar with the one which had been designed, (which appeared during flight trials), the program to put the NIMROD AEW-3 into service is being delayed two to three years. In Western specialists' opinion, the first of the 11 planned NIMROD AEW-3 aircraft will not enter service earlier than the end of 1986. After this, the 8th squadron will be used by the NATO command for executing operationsl missions in support of the entire bloc. However, in this case, the administrative control of the squadron and its material-technical support will be entrusted to the command of the British Air Force.

Combat ready DRLO and control aircraft are deployed by the headquarters of the NATO AWACS command in accordance with the requests of the supreme commanders of the bloc's armed forces in Europe, the Atlantic, the Straits of La Manche zone commander-in-chief, and of the air defense zones commanders (ATOCs). On the basis of these requests, the commander assigns specific missions to the commander of an operational air base or the English DRLO Squadron.

The command plans the DRLO and control aircraft crews' combat training by quarters taking into consideration tentative requests and existing training programs. At the end of each quarter, the NATO DRLO and control forces commander conducts a conference with representatives of the interested commands and their staffs. During it, recommendations are worked out for the rational employment of DRLO and control aircraft in each ATOC's zone of responsibility and of the command of the allied Air Forces in the northern European TVD.

The main method for the operational employment of E-3A aircraft, as the Western press emphasizes, is for them to conduct a combat patrol in a area. A typical flight lasts 8-10 hours, of which, as a rule, more than 2 hours are spent in transit to and from the patrol area. During the flight from a main operating base, if the duty zone is located at a significant distance, the flight is completed at an altitude of 8,500-9,000 m and the patrolling at an altitude 8,500-9.000 m. Upon arriving at the assigned region, the aircraft shifts to the operational subordination of the command, on whose request it will complete the mission. Direct control of the aircraft is carried out by a TsUO of NATO's Joint Air Defense System (the flight is accomplished in its area of responsibility). The flight mission is issued as an operational order, which usually is given to crew members and is studied by them on the ground, and in individual cases, in the air upon arrival in the patrol area. After the completion of the mission, the aircraft returns either to the main operating base or lands at the nearest forward operating base and subsequently operates from it. (Fig. 4)

According to NATO military experts' views, during the intensive employment of EW systems, the most effective method of the combat employment of the E-3A is their patrolling in pairs in neighboring areas with some overlapping of controlled air space and altitude separation. In a threat period, the number of aircraft may be on combat watch which, together with ground-based and shipborne radars, can form a continuous field of radar detection several hundred kilometers wide along the borders of Warsaw Pact countries. American E-3A/B DRLO and control aircraft which (in addition to the territory of the

USA) are based in many regions of the world, including Iceland, the FRG, and Saudi Arabia will be used for this if necessary.

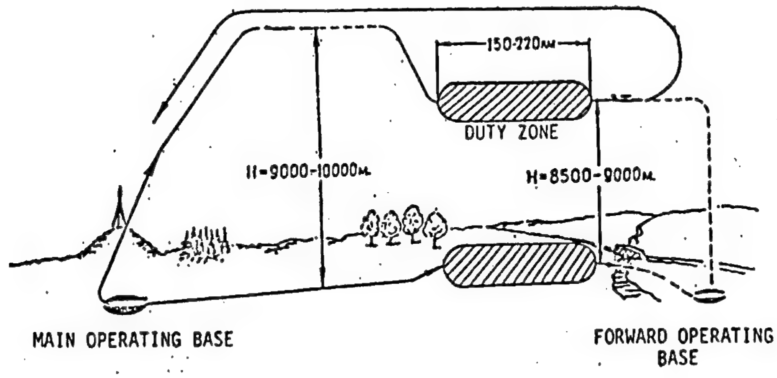

Figure 4. Schematic of an E-3A Aircraft Flight in the Combat Patrol Area (Duty Zone) and Recovery.

Foreign military specialists note that the deployment of the AWACS in NATO's Joint Armed Forces provides a significant increase in the operational capability, the timeliness of decision-making and the effective employment of various weapons. They consider that this system ensures the detection of low-flying targets at great distances, the reduction of time for the guidance of fighters to such targets and their destruction (before approaching the target), and thanks to this, the capabilities of the forces and resources of NATO's Allied Air Defense System in Europe is significantly expanded.

9355
CSO: 1801/87

U.S. STEALTH PROGRAM DISCUSSED

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 85 (Signed to press 11 Nov 85) pp 49-51

[Article by Col F. Dmitriyev, Candidate of Technical Sciences; "Work on the U.S. Stealth Program"]

[Text] One of the characteristic peculiarities of the arms race, unleashed by the militaristic circles of the USA and the NATO bloc, is the planning for the qualitative improvement of the means of armed conflict in the distant future. According to NATO strategists' plans, this presumes the use in weapons and military equipment of future methods and resources, based both on the assimilated achievements of scientific progress, and on those which are at the present time in the conceptual stage of development. In this case, Western military experts consider that such an approach allows military-technical ideas based on new material capabilities and discoveries during basic and applied research, and not occurring in the past because of their technical unfeasability, to be fully implemented.

The STEALTH program--a program to develop aircraft, pilotless vehicles and cruise missiles which are difficult to detect by radioelectronic and infrared air defense systems--relates to the specific measures of the Pentagon in this sphere, and widely discussed in the foreign press.

Work on the program began in 1977, but recently received a new impetus in connection with the missions assigned to the U.S. Air Force to provide, in the 1990s, effective strikes by tactical aviation through the entire depth of the TVD. Thus, as can be judged by foreign press materials, it was considered that solving this problem by improving airborne electronic warfare (EW) systems by using the significant achievements emerging in the realm of radar and infrared technology will not be successful. In particular, it was determined by U.S. and NATO military specialists that such EW systems as anti-radiation reflectors and radioelectronic suppression devices which radiate noise and mutiplex pulse interference signals would be practically ineffective in the 1990s. It is considered that their operations would be neutralized almost completely by the employment of phased-array type antennas; improved moving target indicators; modes for the rapid shift (from pulse to pulse) of the carrier frequency and the frequency of the return pulses, etc. Thanks to the emergence of new multi-spectral aircraft infrared detection systems, the

effectiveness of existing and future IR interference and decoys have been significantly reduced.

It is noted in the foreign press that precisely the above noted circumstances forced American developers of aviation equipment to recall the experience acquired by Lockheed during the development of the U-2 and especially the SR-71 spy plane. It is reported that the primary directions in the firm's work, to reduce the degree of these aircrafts' detectability, was preserved in the STEALTH program: the reduction in the intensity of the power plant's infrared radiation and a decrease in the airframe's radar cross section (RCS). At the same time, questions regarding a further increase in the effectiveness of the operations of EW systems were addressed for this program. In addition, other possibilities for aircraft to overcome future enemy air defense systems were researched within its limits.

The greatest efforts were launched within the area of reducing the radar detectability of an airborne vehicle by decreasing its RCS. It is especially emphasized in the foreign press that an effective reduction in the detectability of aircraft by air defense radar systems can be sufficiently achieved only with a significant decrease in RCS. This conclusion is based on the following dependence between the range of operations of a typical radar (R) and magnitude of the RCS (O) of its detected aerial target: $R=(ko)^{1/4}$. It is presented graphically in Fig. 1. It is evident from the graphic that with a 30-per cent decrease in the RCS, the range is reduced by 16 per cent, and with a 75-per cent decrease in the RCS, range is reduced by 29 per cent. This shows that with a sharp decrease in RCS, the enemy's air defense radar's operating range of operations can become so short that the aircraft is considered to be practically invisible if, while overcoming the air defenses it will remain at a fixed distance from the radar the entire time, including flight at high altitudes. Is it possible to achieve this? American military specialists, working on the STEALTH program answer this question affirmatively and cite the example of the B-52 and B-1A, the geometric dimensions of which (length, height, wing span) differ by approximately 10 per cent, but their RCS differs almost by a factor of 10 (100 m^2 for the B-52 and 10 m^2 for the B-1A at a wave length of 10 cm). But this is not the limit. Statements of separate aviation equipment developers concerning the possibility to increase the RCS of future aircraft to hundredths of a square meter and less, appear in the Western press.

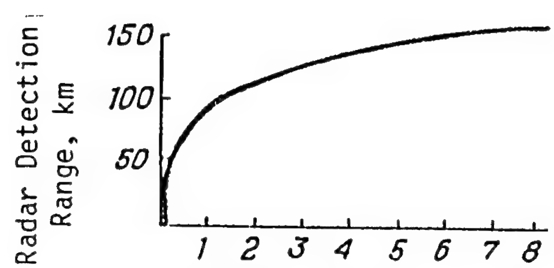

Figure 1. Graph Showing Radar Range as a Function of an Aircraft's Radar Cross Section (RCS).

Judging by foreign press reports, at the present time, work in the U.S. to decrease the RCS of airborne vehicles is being conducted along the following principal lines:

-- Perfecting the frame configuration. It presumes, in particular, the potential decrease in the surface area, the elimination of surface intersections, especially 90^0 angles, the replacement of planes with curved surfaces, and also the emergence and elimination of resonating components, the length of which are multiple half-wave lengths of the radar signals illuminating the aircraft.

-- The assimilation of manufacturing technology and the processing of composite materials, which do not reflect electromagnetic energy, in order to use them to replace traditional materials used in aircraft construction.

-- The development of highly effective coatings which absorb or scatter radar signals' electromagnetic energy.

It is believed that by realizing the first of these directions, it will be extremely difficult to achieve a compromise between the aircraft's shape, having a minimum RCS, and satisfactory flight characteristics. It is planned to solve this problem by the wide use of computer-aided design. The effectiveness of such design methods can be ilustrated by the following example. The American B-52 STRATO FORTRESS and F-4 PHANTOM aircraft were developed ignoring the requirements to reduce the RCS, and its magnitude is equal to 100 and 5 m^2 respectively. The F-14 TOMCAT and F-15 EAGLE fighters were developed considering such a requirement, and their RCS is around 3 m^2. The F-16 FIGHTING FALCON and the B-1A stemmed from the greatest possible reduction in RCS during the design stage, and this specification is 1.7 and 10 m^2 for them.

A still more interesting example is the experience acquired in reducing the RCS of the B-1B bomber. The foreign press reports that on this aircraft, because the radioelectronic defensive system antenna, located in the vertical stabilizer, was replaced with an antenna built into the fuselage, the curvature of the leading edge of the wing panels was changed, and the air intake sections were improved, the B-1B's RCS was reduced to 1 m^2. As a result of computer computations, numerous aspect models of the prospective aircraft, designed using the achievements in STEALTH technology, were constructed.

The second direction to reduce the RCS is the employment of new non-metalic construction materials, so-called composites. American military experts consider that in the future, 50 per cent (by weight) of the elements, components and units of flying systems will be manufactured by them. Their insufficient strength especially fatigue, and in a number of instances, the high manufacturing and processing cost is hindering the U.S. aviation industry from rapidly assimilating these materials.

It is noted in the Western press that in recent years, within the realm of perfecting antiradar coatings, considerable successes have been achieved in the expansion of their frequency band and reduction in specific weight. It is reported, in particular, that the development of coatings 2.5 mm thick, provide an absorption of radar signals with a wave length from 2.3 to 3.6 cm by 10 dB. According to estimates of foreign specialists, this halves the operational range of such radars. A special problem is considered to be the

coatings' insufficient heat resistance that leads to their burning up at super and hypersonic speeds, and a high friction coefficient. It is believed that it will be impossible to achieve, in the near future, a sharp reduction in the specific weight of the materials used in the coatings. Therefore, it is not intended to put them on the entire surface of the aircraft (except for special reconnaissance aircraft), but only on those parts of the frame which strongly influence the over-all RCS.

In a number of foreign publications, an opinion regarding the limitation of possibilities to decrease the RCS is being expressed. The authors of these articles think that STEALTH technology will be the most effective only against those ground radars most widely deployed at the present time. For example, Fig. 2 is a graph showing the dependence of this technology's effectiveness on the radar's operating frequency. The graph's form is explained in the following manner. At frequencies near 30 MHz, the RCS will increase sharply, since the entire airframe, equal to a length of approximately 10 meters, approaches the radar's resonant frequency, and the "smoothness" in the surface junctions scarcely affect the magnitude of the REC at these frequencies. On the other hand, at frequencies of more than 10 GHz, any unevenness in the airframe begins to act like angled reflectors, which is all the more difficult to eliminate.

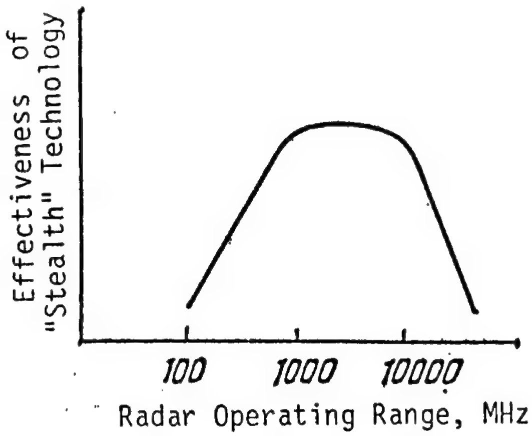

Figure 2. Graph Showing the Effectiveness of STEALTH Technology as a Function of Radar Operating Frequency.

On the basis of these considerations, foreign specialists concluded that radars, as before, should remain the primary means for air surveillance, and therefore their essential improvement is required, especially in the realm of expanding the frequency range, the adoption of automated systems and the joining of a number of radars into a net with the simultaneous organization of information exchange between them in digital form.

The reduction in the intensity of IR radiation is primarily considered with respect to the aircraft's engines since the aerodynamic heating of the airframe, even at very high speeds, is considered to be inconsequential from the point of view of its detection by IR systems. For example, with a speed of M=0.9, the greatest heating of the airframe does not exceed 50^{0} C. However, for hypersonic speed aircraft, it is necessary to consider the cooling of their sheathing.

For the engines, an effective method is considered to be the use of various types of screens, covering their hottest parts and putting various gaseous mixtures into the exhaust, which decrease the intensity of IR radiation or change its spectrum. In so doing, they are trying to preclude or reduce the

degree of IR radiation in the most widely utilized missile guidance heads in the 3-5 mkm wave band.

The task of screening IR radiation has turned out to be highly complex since, during the development of the screens, it was necessary to consider their influence on the aircraft's aerodynamic properties and the potential increase in its RCS. One of the solutions in this area is believed to be the proposal to use moveable screens in the air intakes and engine nozzles.

Judging by foreign press reports, the work on the STEALTH program not only does not exclude the process of perfecting EW devices, but on the contrary, adds several new dimensions to it. The first consequence of adopting the program was the U.S. Defense Department's requirement to abandon suspended containers for aircraft radioelectronic suppression equipment in favor of equipment built into the fuselage. The second aspect is, the incorporation of phased array antennas into EW equipment. And finally, it is believed that future EW systems' combat capabilities can be increased sufficiently easily, as new systems belonging to the likely enemy appear.

This fact speaks to the complexity of work on the STEALTH program. In 1982, the English firm Ferranti reported that it had developed a method for the automatic system analysis of radiotechnical and weather reconnaissance data on board the aircraft for overcoming air defenses and for the purpose of determining anamolies in the propagation of radar signals. The results of such analysis can be used by the aircraft's crew for secret flight through the radar's operating zone. Specialists of the firm state that although they employ such a method under specific weather conditions, its utilization in combination with other resources and methods can significantly increase the effectiveness in overcoming air defenses.

The STEALTH program is a clear example of the aggressive trends in the development of science and technology in imperialistic countries. The stakes of taking the lead in one of these highly expensive fields to perfect the means of armed conflict costs the American tax payers, according to the acknowledgement of the foreign press, an enormous sum, assessed by various sources to be from 1 to 10 billion dollars. At the same time, according to many foreign specialists, the STEALTH program, as any other attempt to develop the "absolute" weapon, cannot justify all the hopes which the Pentagon places on it.

9355
CSO: 1801/87

AMERICAN ADVANCED TACTICAL FIGHTER DESCRIBED

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 85 (Signed to press 11 Nov 85) pp 52-56

[Article by Col Yu. Alekseyev, Candidate of Technical Sciences; "The American Advanced Tactical Fighter"]

[Text] Within the overall system of U.S. militaristic preparations, directed at achieving military superiority over the Soviet Union, the Pentagon is paying special attention to equipping all branches of the armed forces with new equipment and weapons. The Advanced Tactical Fighter (ATF), which American specialists began developing during the second half of the 1970s, is considered to be such an example for the air force. By the end of the 1970s, the U.S. Air Force, along with leading aviation firms, completed a number of research investigations. Judging by foreign press reports, the analysis of combat missions with air and ground targets, an assessment of potential aircraft aerodynamic structural designs, and of the prospects for employing new construction materials and technologies (including STEALTH technology) were conducted. Also, several future aircraft weapon systems were examined. During the investigation, aircraft with both supersonic and subsonic flight cruise speeds were analyzed.

At the beginning of the 1980s, the air force command had arrived at the single opinion that the ATF, intended to replace F-15 and F-16 fighters in the future, must have a supersonic cruise speed, take-off and land from a short runway (VPP) having a length of approximately 600 meters, execute combat missions by conducting strikes against ground targets in any weather conditions, and achieve air superiority. The European theater of war and the Near East are considered the primary regions for its operational employment. The U.S. Air Force command's specifications for the ATF, compiled from materials in the foreign press, are provided below.

Western journalists note that the ATF is not expected to enter service before 1994-1995, and U.S. Air Force specialists intend, as soon as possible, to investigate and assess the key technical and technological solutions which can be used in the design with an acceptable degree of risk. One of the serious problems is considered to be the balancing, at a known standard, the contradictory characteristics of supersonic cruise speed and a short take-off and landing.

Crew...1

Take-off weight, kg
Aircraft optimized for air battle.........................about 27,200
Aircraft configured for land targets......................about 36,300

Combat radius, km..1,000-1,500
Ferrying range without in-flight refuelling, km.................5,500-6,000
Cruising speed at high altitude..................................Supersonic

Acceleration time, sec
At sea level, from M-0.6 to M-1.0.....................................20
At altitudes of 6,000 to 9,000m from M=0.8 to M=1.8..................50

Maximum rated overload while retaining 80% internal fuel:
positive...9
negative...3
Maximum operational overload:
available when maneuvering at 9,000 m through M=1.0(2.5)...more than 5(6)
at 3,000 m through M=0.9...9
at 15,000 m through M=1.5................................more than 2
Characteristics of a sustained turn in the flight range of from M=0.4 at 6,000 m up to Mach more than 1 at 12,000 m:
turning rate, deg/sec...12
available overload duration of no less than 30 sec...................9

According to American experts' opinion, supersonic cruise speed, in combination with a high maneuverability at this speed, provides the capability to overcome enemy air defenses at high altitudes (but not at low altitudes as with previous-generation fighters). This calculation is based on the fact that the time an aircraft is within the destruction zone of air defense systems will be significantly less than their reaction time, and the maneuver capabilities of the fighter are considerably greater than the maximum parameters of the targets which these systems are intended to destroy. At the same time, it is intended that the supersonic flight cruise speed will be achieved without afterburners, and the afterburner will be used to accomplish short takeoff and for combat maneuvering. The requirements for a short takeoff and landing are connected primarily with the necessity to support the aircraft's combat employment from damaged runways under European theater of war conditions and from prepared dispersal airfields in other regions. American military specialists hope that if after the delivery of a strike by the enemy on the VPP, and it is possible to repair only two to three craters per hour, then in this case the sortie rate of ATF fighters from a damaged runway is reduced not more than 20 per cent.

The question of using STEALTH technology in the ATF (that is, to employ it to any extent) is discussed in the West much less. This explains the paramount importance of other problems, in particular the difficulties of searching for an acceptable compromise solution between STEALTH technology and the

significant heating of the air intakes and airframe during a long flight at supersonic speeds. It is believed, however, that it may be possible to reduce the fighter's radar cross section (RCS) by an order of two, and, as a result, it will be within the detection zone of the radars inputting to air defense missile batteries, only for a few seconds.

If, as Western journalists assume, separate elements of STEALTH technology are used in the AFT, the wider its use must be expected in the F-19 fighter, intended for special reconnaissance missions and the suppression of air defense systems. Judging by Western press materials, Lockheed is developing this aircraft, and its trials are being conducted at Nellis Air Base. In external appearance it resembles that firm's A-12 aircraft. Its power plant comprises two F-404 bypass turbo-jet engines, and is meant to be transported to operational areas use by C-5 heavy military-transport aircraft (without prior disassembly).

According to the layout diagram, it is expected that the ATF will be aerodynamically unstable, and all its onboard systems will be integrated by a digital electronic remote control system. This should insure stable engine operations in near-surge modes, and also when executing high-energy maneuvering.

A great deal of attention is being paid to the question of mounting "air-to-ground" guided missiles, considered to be the primary kind, on the aircraft. According to a majority of American military speacialists' opinion, the ATF's maximum flight speed with weapons onboard should be close to the speed without external suspensions. They assume that this can be achieved by its so-called superconformity suspension. A guided aircraft cassette with a carrying frame, loaded with precision guided munitions, is one of the potential types of weapons being considered. At high altitudes and supersonic speeds, the cassette can be used without an engine, and at low altitudes--with an engine (a booster). The guidance system for the middle portion of the flight path can be inertial.

Western experts believe that it will be possible to employ either the onboard system (a synthetic aperture radar or a forward-looking IR unit), or specialized systems (the reconnaissance-strike PLSS installation, or the JSTARS radar system) for detecting ground targets. The radar is preferred as the onboard system because, according to research conducted in the West in this case, the aircraft will be able to complete up to six sorties per day in the European theater of war in January--the month with the worst weather. At this time of the year a fighter, designed for use only during daylight, will be able to complete an average of one sortie per day, and overall, it will be unusable for 14 days. By equipping the ATF with a forward-looking IR set, the calculated average rate of its combat employment is 2.25 sorties per day and will be unusable for 5 days.

The question of choosing the "air-to-air" guided missiles is considered to be less complicated. Leading foreign journalists agree with the idea that the missile weapon for executing this type of missions will be a compromise between the AIM-20 and AIM-9 SIDEWINDER, and the so-called variable-aspect 30-mm cannon will be employed as a weapon for close-in aerial combat. By

"variable-aspect" is understood the capability to fire on maneuvering targets at large approach angles, which the onboard flight and weapon guidance system must provide. The capabilities of such a system were already demonstrated in 1982, during the flight trials of specially equipped F-15B fighters. In particular, a maneuvering target (the PQM-102 target, flight speed 780 km/hr, g-load of 4) was attacked with an approach angle of 130^{0}. In this case, the F-15B had a speed of 740 km/hr and completed a turn with a g-load of 3.3. The onboard radar locked on the target at a range of 3,000 m, the pilot began firing from the onboard cannon at a range of 1,770 m, and carried it out for 2 seconds. As a result, of 171 rounds, nearly 30 hit the target.

In order to insure the high effective combat employment of the ATF, its onboard systems are intended to be developed according to the "self-repair" principle, that is, in case any subsystem or its components fail or are put out of commission, the system, on the basis of self-diagnosis, selects those duplicate or reserve channels, which insure that the functions of the failing subsystem are carried out. In this case, American experts assume that a tenfold increase in the reliability of flight control system can be achieved. It is considered to be advisable to implement the principle of self diagnosis operation of the onboard system by the utilization of an electronic artificial intelligence system.

Boeing, General Dynamics, Grumman, Lockheed, McDonell Douglas, Northrop and Rockwell participated in the beginning stage of the ATF's preliminiary design, but the overall leadership was accomplished by a special directorate created in the air force. At the end of 1984, it was decided to select two or three firms to continue the work. According to foreign press reports, in the U.S. Defense Department's five-year plan for FY 1984-1989, it is planned to appropriate 1.6-2.08 billion dollars for the development of the ATF.

The demonstration of a short takeoff and landing is considered to be an important stage, on which the full-scale development of the fighter will depend a great deal. For this objective, an F-15 aircraft was selected which will be appropriately re-equipped for conducting several hundred test flights. In particular, rectangular cross-section axially asymmetrical nozzles with a controlled vector and reverse thrust will be installed in it. At the present time, judging by Western press materials, leading American engine-manufacturing firms have developed such nozzles, which can insure a decrease in the length of the takeoff run by 35-40 per cent (by deflecting the thrust vector downward) and the length of the landing by 75 per cent (by reverse thrust). It is assumed that a future system to increase the lift force will also undergo trials on the F-15 demonstration model. The flight control system will be combined with the engine and nozzle control system. In addition, it is planned to test the so-called floating landing gear, capable of providing aircraft operations from ground having an unevenness in height of 0.23 meters for each 24 meters.

In 1984, the U.S. Air Force command intended to begin carrying out another demonstration program to assess the fighter's viability at a supersonic cruise speed. The experimental aircraft must have an air frame of promising design with a decreased RCS at supersonic cruise speed and be compatible to a certain extent with short takeoff and landing technology. It is also planned to

verify the developed concepts of the aerodynamic design and control, necessary to provide the required maneuverability characteristics at high speeds and altitudes. One of these is the close-looped control system for the aircraft's heating system, in which fuel is used as a coolant. It is expected that the superconformity weapon suspension system (directly attached to the airframe without the use of mounts, pylons and other adapters) will undergo trials.

Other large experimental programs for assessing the potentials of future technology, having, according to Western military specialists' opinion, the most direct application to the development of the ATF are the following:

-- YF-16CCV--trials of a direct control system of aerodynamic forces, conducted in 1976-1977 on the YF-16 aircraft.

-- HiMAT (Highly Maneuverable Aircraft Technology)--trials of future technology on a pilotless vehicle in order to assess the potentials for a significant increase in the maneuverability and combat effectiveness of new-generation fighters. Rockwell has been conducting them since 1979. The firm's specialists believe the HiMAT system to be a prototype (a scale of 0.44:1) of a 1990's fighter. The following future technologies are being tested on it: aeroelastic construction; leading aerodynamic surfaces located near the wing; a wing with a supercritical profile and variable curavature; a complex flight and engine control system; and new composite materials. The calculated fighter specifications, which, according to Rockwell's assessment, may be realized in the 1990s based on results of the HiMAT program, shown below:

Take-off Weight, kg	7,730
Combat Weight at 9,000 m with speed of M=0.9, kg	6,840
Fuel Load, kg	1,790
Maximum Speed at High Altitude, Mach No	1.6
Radius of Operation, km	550
Allowable Overload in Sustained Bank at 9,000 m through M=0.9	8
Maximum Calculated Overload	12
Engines:	
Type	TRDD
Thrust at 9,000 m through M=0.9, kg	5,660
Thrust-Weight Ratio:	
At Take-Off	1.43
At Combat Weight	0.828
Aircraft Dimensions:	
Length, m	13.42
Height, m	2.84
Wing Span, m	10.52
Wing Area, m^2	27.72

AFTI (Advanced Fighter Technology Integration)--the integration of new technology into a future fighter. Flight trials for this program have been

conducted since 1982 with an appropriately re-equipped F-16 fighter which received the designation AFTI/F-16. The first stage of the trials was carried out primarily to assessment a three-channel digital flight-control system, which was installed instead of a four-channel analogue system, which is standard on the F-16. During the second stage of the program, an automated weapons control system was tested. It provides weapon employment while maneuvering the aircraft. [1]

The development of the concept of the MAW (Mission Adoptive Wing) is part of the AFTI program. It is intended to demonstrate the potential of a smooth change in the curvature of the wing's profile during flight in order to provide better conformity of the shape with regard to the flight mode. One of the F-111 aircraft, used earlier in the research programs, is being re-equipped for the trials. A deflecting nose (downward to 15^0) and the trailing edge of the wing (upward to 4^0 and downward to 19^0) were installed on it. Trials are planned to begin in 1985.

-- X-29--The development of an aircraft with a reverse wing sweep. The primary mission of this research program is considered to be the assessment of the actual potential capabilities and prospective utilization of such a wing.[2]

American specialists intend to implement the new design decisions and technology being planned for the introduction into the AFT, on the basis of the wide use of new construction materials and their production process. Thus, when selecting the construction materials for the ATF, it is recommended that serious attention be paid to the radio absorptive properties. Judging by foreign press reports, several developed composite materials, in particular carbon and thermoplastic, have good radio absorptive properties. At the same time, it is noted that the problem of developing an industrial process to introduce radio absorptive components into an aircraft design is very difficult, although some experience in this field is being accumulated: radio absorptive materials are being employed in the design of the A-10 attack aircraft (they comprise 20 per cent of the wing area). Such materials are able to sustain high temperatures (more than 270^0 C.) and aerodynamic loads.

The American firms participating in ATF development proposed a number of designs, each of which is characterized by one or another design peculiarity. Thus, Lockheed's design (take-off weight of more than 50,000 kg, maximum flight speed M=3.0) outwardly resembles the SR-71 reconnaissance aircraft. In it, it is intended to use new aluminum alloys and to use titanium only for making parts being tested for high heat (for example, engine nacelles), and composite materials--in the internal elements of the structure. McDonell Douglas submitted two designs. The first--a fighter, optimized for executing air superiority missions. It has a large trapezoidal-shaped wing with small induced [lift] and shock-wave drag. The aircraft's design characteristics are: take-off weight 18,000 kg; steady-state g-load of 5 at an altitude of 9,000 m at M=0.9, and 6 at M=1.6; acceleration speed from M=0.8 to M=1.6 at this same altitude, approximately 50 seconds; required runway length of 300 m. The power plant consists of two augmented bypass turbojet engines with two-dimensional air intakes and axially symetrical supersonic nozzles with reverse thrust. The second design is an aircraft optimized for operations against ground targets. It has a take-off weight of approximately

15,700 kg, a maximum speed of M=1.7, a combat radius of 460 km and can be employed from a 900-m runway.

Analyzing the proposed designs, Western specialists synthesized their mean characteristics for the future aircraft: maximum take-off weight 32,000 kg, 7,000 kg combat payload, cruise speed M=1.8-2.2, power plant--two engines with an afterburner thrust of 11,000 kg.

American experts believe the engine development which is proceeding according to the JAFE (Joint Advanced Fighter Engine) program under the general leadership of U.S. Air Force's Jet Engine Laboratory to be one of the key issues in ATF development. In October, 1983, contracts amounting to 203 million dollars over a period of 50 months for the development of demonstration engines were concluded with General Electric and Pratt and Whitney (U.S. Air Force requirements for an engine, compiled from foreign press materials, are given below).

Thrust without afterburner, kg............................about 12,700
Specific weight...0.1
Doubleflow modulus.....................................not more than 0.3
Turbine inlet temperature at continuous
    cruising speed, ^{0}C...............................up to 1,540
Number of high-pressure compressor stages.........................5-6
Degree of pressure increase
    Fan..high
    internal loop..moderate
Turbine linkage of blower and high-pressure compressor...single-stage
Mean time between failures, h.....................................400

Each of the above-named firms intends to employ various technical and technological solutions. For example, General Electric is developing the GE37 engine with a varyiable work cycle, having a high degree of bypass at subsonic speeds and low at supersonic. In it, it is envisaged to manufacture the non-rotating components from composite materials, and the turbine blades from powder metallurgy alloys. The firms' specialists plan to decrease the number of fan and compression stages by increasing the rotor's rotational speed and improving the aerodynamic characteristics of each stage. As a whole, they intend to decrease the number of engine components by 50 per cent in comparison with similar state-of-the-art engines.

Pratt and Whitney is now developing the PW5000, an augmented bypass turbojet engine based on the extensive use of promising materials and technology (monocrystal turbine blades with a thermal protective coating, ceramic materials in the seals of the non-rotating components, a combustion chamber with a so-called floating baffle and others). Special attention is being paid to insuring the stability of the turbine blades against damages and the slight tendency for cracking. The firm proposes to maintain the service life of the

"hot" engine parts up to 50 per cent of the engine's service life as a whole, and the "cold" to 100 per cent.

Trials of the first models of the engines being developed are planned to begin in 1986. It is expected that the selection of the firm to continue the engine development will be made in 1988. However, extent of the full-scale development has not been determined. According to Western specialists' assessments, the U.S. Air Force will purchase approximately 15 engines for ground trials and several for flight tests. They assume that the new-in-principle engine will be able to be used on the F-15 and F-16 fighters.

According to foreign press reports, further work on the program to develop the ATF is intended to be completed within the following timeframes. In 1986 it is intended to select three to four firms to develop a demonstration model of the aircraft, and in 1988, one (or a group of firms) for the full-scale development, which will allow flight trials of the fighter to start in the beginning of the 1990s.

1. For information on the trials of the experimental AFTI/F-16, see: "Zarubezhnoye voyennoye obozreniye," No. 4, 1984, pp. 48-49.

2. For information on the X-29 aircraft, see: "Zarubezhnoye voyennoye obozreniye," No. 3, 1985, pp. 47-50.

3. Concerning this, see: "Zarubezhnoye voyennoye obozreniye," No. 10, 1984, pp. 52-57

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CSO: 1801/87

ATLANTIC CONVOY SYSTEMS DISCUSSED

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 85 (Signed to press 11 Nov 85) pp 57-64

[Article by Capt 1st Rank Yu. Galkin; "Convoy Protection in the Atlantic"]

[TEXT] The high commands of the U.S. Navy and the other countries of the NATO militaristic bloc, in their agressive plans for preparation and conduct of war at sea, are paying considerable attention to the question of the organization and support of convoys. During the Second World War, convoys played an important role in technical and materiel resupply of the forces of the warring countries and supplying raw materials for their industries. In the Atlantic alone, as many as 8 convoys, of 30-60 ships each, in addition to a large quantity of separate, independent sailings, were simultaneously at sea. In all, during the war, over 3,000 convoys (almost 90,000 ships) plied the Atlantic, which were protected by more than 4,500 antisubmarine ships and 5,000 aircraft.

The importance of the Atlantic sea lines of communications (SLOCs), as emphasized in the foreign press, will grow significantly in future wars, since the strategic transportation of troops, arms, combat equipment, raw materials and other military-technical products will be carried out over them. As the foreign press has reported, in order to reinforce the joint NATO forces in Europe, it will be necessary to transport from North America more than 1 million troops, about 10 million tons of military cargo and 17 million tons of POL. To supply these quantities, NATO experts figure that there will have to be 100 ship arrivals at European ports daily. The ships must transit both in convoys and independently and the issue of their defense has taken on considerable importance.

In this article we will review convoy defense organization only during transit, in the regions of coastal waters and, in skerries.

Western defense specialists believe that the organization for shipping in convoys has undergone substantial change since WWII. This has been caused by the rise of a number of factors, primary among which are: a sharp increase in the significance of the Atlantic as the most important transportation link between Western European countries and the U.S.; a progressive growth in the volume of military and commercial cargoes to Europe either in wartime or under

emergency conditions; the appearance in capitalistic countries' merchant fleets of high-speed ships with large gross capacity, which can transit the Atlantic independently; the establishment in NATO countries (and primarily in the U.S.) of conditions for providing effective means of defending Atlantic SLOCs, mainly by the continuous deployment of forces and systems as well as operational facilities of maritime theaters of military operation; the growth of firepower of surface ships, submarines and aircraft; the widespread introduction into the fleets of guided missile weapons; and means of radio and radar surveillance, including space-borne systems.

The foreign press notes that, compared to WWII, when the main forces used against convoys were submarines, the threat spectrum in modern times has considerably broadened. Strikes on convoys, including nuclear strikes, can be made by atomic and diesel submarines, guided missile ships, and aircraft of Naval aviation and the Air Force. With this situation, NATO navy commanders must seek out optimum routes for convoy defense. The current situation means that one cannot regard SLOC defense as a simple protective operation, it must also assume an active offensive character with the goal of forcing the enemy to engage in battle under conditions unfavorable to himself and on unfavorable axes. In this connection, the comments of the British theoretician, Admiral Reginald, are significant, "An opinion persists that escort ships only protect convoys. In my opinion, one must use them in such a way as to destroy the enemy before he opens fire on the convoy or force him, in general, to decline to fight or, to fight under conditions unfavorable to him." Today the principle of active and offensive protection of convoys is constantly repeated in the course of training among combined NATO navies. In fulfilling these tasks, they use carrier multipurpose strike (AMG) and hunter-killer groups (APUG), surface strike groups (KUG) and surface ship hunter- killer groups (KPUG), land-based patrol aircraft and airborne warning and control (AWACS) aircraft E-3A, operating at considerable distances from the convoy transit routes along the most serious threat axes.

NATO military leadership, together with specialists in naval matters, has studied, in great detail, the lessons of the Falkland conflict, paying important attention to the experience of using various types of merchant ships, including those equipped with containerized weapons systems. In their opinion, bringing into maritime transport, side by side with the convoy, an even greater quantity of high speed, heavy-tonnage ships with self-defense systems, capable of independent sailing without the need for constant protection, will create most serious difficulties for the enemy and will force him to increase his forces and systems for search and destruction of these ships--which will lead to a lowering of the combat stability of his fleet's forces.

Today, the majority of NATO countries are studying various systems for equipping merchant ships with autonomous containerized weapons systems which could be installed on ships in a short time. They are analyzing the experience from the Falkland (Maldive) Island campaign of employing the American ARAPAHO air antisubmarine system in combat action against Argentina. Also, the possibility of deploying the British SCADS anti-air system on merchant ships is under consideration. As the foreign press notes, both these

weapon systems can be installed on a ship in the same time as needed for onloading general cargo.

Nevertheless, NATO naval strategists consider that the convoy system will continue to be one of the basic means of protecting the transit of military and commercial goods during wartime, regardless of type. The convoy allows greater economy, concentration and effective use of protective forces. To ensure successful transits, regional commands' forces and resources, operating in the transit zones, can be used. Furthermore, maneuvering by protective forces reduces the enemy's combat capabilities and, the presence of combatants in the convoy formation enhances morale of the merchant crews.

Moreover, the defensive organization of convoy shipping has a number of substantive shortcomings, including (according to Western specialists) limited convoy speed due to the inclusion of slower ships in the convoy; considerable time spent in waiting for the onloading of all convoy ships, which lowers their coefficient of effectiveness by about 30-50 per cent. Also, concentrating large numbers of ships in a convoy permits the enemy to strike with massed nuclear missile attacks and it also widens the opportunity for submarines and aircraft to choose targets.

A convoy, according to the foreign press, is a grouping of merchant or navy support ships, gathered under a single command for an ocean transit in company, under the protection of aircraft and combatants (Fig. 1). A convoy which includes only merchant ships is called a merchant convoy, while one containing navy support ships is non-merchant. All questions related to control of merchant and non-merchant convoys come under the competence of the Naval Control of Shipping Office (NCSO), which controls shipping in wartime, provides sailing safety of merchant ships, develops recommendations for improving the control organization, and coordinates convoy defense activities and individual sailings with other interested agencies and institutions of NATO countries. NCSO is also responsible for convoy formation, laying out and changing tracks, organizing plans for mutual support against attack and warning convoys and individual sailings about conditions in the area of their routes.

NATO amd the U.S. command classify convoys as follows:

By size--(up to 10 ships), medium (up to 30), large (up to 90), and gigantic (over 90 ships);

By speed of advance--slow (up to 10 kts), medium (around 15 kts), and fast (20 kts and over);

By cargo character--commercial cargoes, troop (personnel, equipment and weapons), and mixed.

Convoy ships, as a rule, form up in columns (5-6 ships each). In small convoys the width of the front is greater than the depth because of shorter columns. In gigantic ones, they assume the shape of a square or polygon.

During open ocean transit, the minimum distance between ships in columns is about 600 yards, with an interval of 1,000 yards between columns. When there

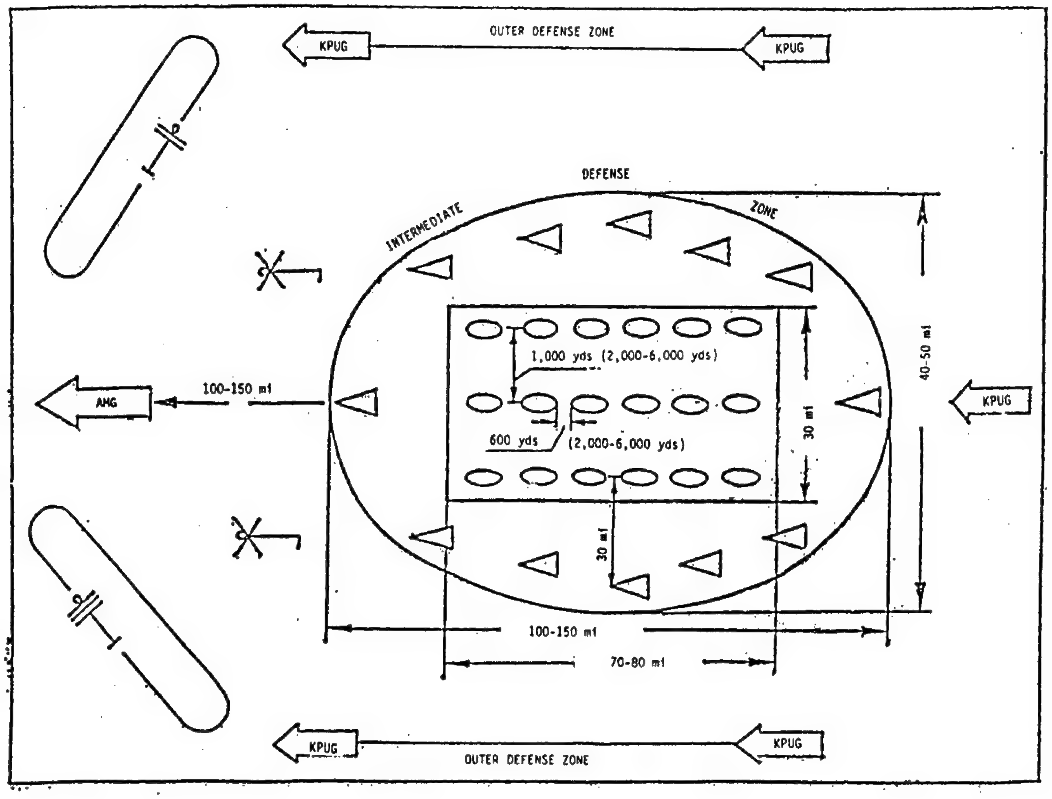

Figure 1. Variant of Conducting a Convoy Transit Ordering
(Speed about 20 kts)

is a threat of a tactical nuclear attack, the distance between columns and ships in them increases and can exceed 2,000-6,000 yards. In coastal zones or narrows, the number of columns decreases because of increases in their length.

On account of specific conditions which are developing in the regions of the oceans and seas where convoy transits are planned, forces, appropriate to the convoy's technical condition, speed and number of ships, as well as the type of primary cargo, will be deployed in its defense. On the average, for a convoy of 50 ships, according to NATO navy specialists, 10-12 escort ships must be assigned (including 2-4 with towed sonar arrays). It is considered that the best defense lies in large convoys, although a very lengthy amount of time is needed to form up.

As noted earlier, submarines and enemy aircraft constitute the primary threat to the convoys during sea transit. Convoy defense is constructed with this point in mind.

ANTISUBMARINE DEFENSE includes close-in screen ships (basically destroyers and guided missile frigates with helicopters on board). They deploy around the defended ships at distances of 4,000-6,000 yards, and their numbers are determined based on calculations to create an unbroken zone of sonar coverage. Their primary mission is the prevention of torpedo attacks on the convoy from enemy submarines.

In the intermediate defense zone (up to 25-30 miles from the ends of the convoy columns) the KPUGs and shipboard ASW helicopters operate. Their main task is to detect and destroy enemy submarines before they reach firing positions. KPUGs as a rule maneuver forward along courses or axes of submarine attack threat.

The outer zone of ASW defense is an area from 40-50 miles up to 150-200 miles from the convoy. In this area are the AMGs, the APUGs, the AUGs, and KPUGs. One of these groups operates along the enemy submarines threat axis, out to 300 miles or more. Shore-based patrol aircraft conduct ASW surveillance in the outer zone.

AIR DEFENSE of the convoy is structured taking into account that its primary forces and systems can be in action in an extremely short time along the threat axis. The inner air defense zone can be covered by close-in screen ships and the merchant ship anti-air systems (containerized air defense systems, air defense installations on high value ships, and systems to set up passive jamming/interference). The intermediate air defense zone is protected by inner and outer zone ships. An air defense ship is designated to control air defense fire from screen as well as merchant ships. The very major and most important convoys can be screened by multi-purpose aircraft carriers, which constitute the outer air defense zone. In this case, carrier-based fighters provide air cover of the convoy and intercept enemy aircraft out to 100-150 miles from the convoy center.

To guarantee proper air defense of convoys at sea, both active (use of fighters and various types of air defense weapons) and passive (diverting around especially dangerous regions, applying special sailing orders, creation of active and passive radar jamming) measures are planned.

MINE DEFENSE. Minefields, established in harbor channels, staging areas and in narrows are a great danger to convoys. Convoy ships are instructed, upon entering a mine field, to follow precisely in the wake of the ship ahead and not to change course without an absolute need. Special degaussing gear, energized when transiting minefields, is installed on some of the merchant ships to minimize the probability of triggering mines. Mine defense is the responsibility of regional commands who also allot assigned resources and forces for minesweeping.

The improvement of the system of naval bases in NATO, especially in the Atlantic; the appearance of modern warships with effective antiship, antiair and antisubmarine weapons; and the widespread use of strategic and tactical aircraft for executing naval combat missions, presaged the appearance in NATO of new ways to defend shipping--"a moving zone of superiority" and "defended SLOC zone."

"Moving zone of superiority" assumes achieving complete sea control and air superiority in a moving zone of 500-600 miles diameter and up to 25 km in altitude along the convoy route. This method, according to the foreign press, will be employed when sailing especially important sea and oceanic convoys, primarily from the U.S. to Europe. This method assumes that a sufficient number of close-in screening forces and operational cover will be assigned. These forces include AUGs, APUGs, KPUGs, nuclear attack submarines and landbased patrol aircraft, which provide effective surveillance of surface, air and subsurface situations in the [sea control] zone and achieve superiority.

The "defended SLOC zone" method presupposes the execution of systematic combat actions by permanent groups of naval forces and other types of armed forces, concentrated in specific operational zones. The objective is to destroy or disperse enemy forces from a given operational zone, and to establish and maintain a favorable operational situation in it. These same forces, in close coordination with air force tactical aircraft, can protect the convoys and independent sailings.

Convoys and independent sailings, as stressed in the foreign press, move separately along two defended movement belts. Their outer sides abut so-called buffer zones, in which ships are not allowed to travel. In the bufer zones, situation control is accomplished by patrol aircraft, antisubmarine airplanes and helicopters. The defensive forces are, at all times, located beyond these zones in several sectors, disposed along the movement routes away from the enemy attack threat axis. This specific means is planned to be employed to defend maritime convoys en route to the European military theater.

In conformity with the existing NATO view, convoy defense can be accomplished in two ways: "zonal convoying" and "open convoying."

In "zonal convoying," operational control and responsibility for organizing all types of convoy defense rests with the CINC in the area and regions of his theater of military operations. Thus, the Atlantic Ocean, north of the Tropic of Cancer, according to NATO demarkation, includes three operational zones, which in turn consist of regions: Eastern Atlantic Zone (North, Central and Biscayne regions), Western Atlantic Zone (Oceania and Canada) and Iberian Atlantic Zone (Gibraltar and Moroccan regions). Within these regions and zones naval groups are established, from which are assigned the necessary array of forces and resources to make up the convoy close-in screening force. When convoys cross from one zone to another, there is a change of operational control and corresponding protective ships.

"Open convoying" is considered a basic means of convoy defense in European waters for operational-tactical transport of troops and cargo in the North, Central and South European theaters of military operations. This form of convoying calls for assignment of ships to the close-in screening force who can accompany the convoy along the entire convoy route--from the staging area to the debarkation point.

Transportation of goods over short distances in the skerry regions and in coastal waters, as a rule, is done with small convoys (2-3 ships in a row

1,000-2,000 yards apart). The convoy tracks hug the coast so that they can quickly turn into the skerries or turn toward shore under the protection of land-based resources. For independent sailings a so-called "dash" mode is employed, the idea of which is that a single ship can quickly move from one coastal point to another with a minimum of protective force. It is considered that a probable enemy's naval force in a SLOC zone will be destroyed incident to executing the mission of gaining superiority in any given maritime region.

Recently, considerable attention is being focused on improving sailing orders and to optimizing the disposition in them of ships with both military and with commercial cargoes. This, in Western military specialists' opinion, will make it considerably harder for the enemy to detect in the convoy the highest value ships, thereby decreasing their losses.

Such methods of shipping defense as "moving zone of superiority" and "defended SLOC zones" are constantly being developed in NATO exercises such as OCEAN SAFARI, TEST GATE, JOINT MARITIME CAUSE and others. This has called for the appearance in the fleets of effective means of detecting submarines (towed sonar arrays, dipping sonar) as well as inclusion in weapon systems on ships and aircraft of long-range antiship missiles. The objective of developing these methods is to determine various different ways of rational use of defensive forces, and optimize the numbers because today, NATO countries, as the foreign press reports, are not in a position to assign required numbers of combatants for convoy defense, but rather can satisfy 50 per cent of the need. In one of his comments, the Commander of OCEAN SAFARI-83, Vice Admiral Lyons, announced that "NATO lacks about 250 escort ships of various classes for Atlantic convoy defense."

During OCEAN SAFARI-83, two convoy variants were tried out. As reported in the foreign press, 16 cargo ships of the UK, FRG, Norway, Denmark and Greece were formed up into two convoys of eight ships each. One convoy sailed from Falmouth to Lisbon via the Azores, and the other in the opposite direction. In the estimation of the experts, the general gross capacity of -each convoy was equal to one WWII convoy, comprised of 40 ships.

To exercise both means of convoying, a NATO strike force was formed in the area of the Azores, consisting of an AMG (CV JOHN F. KENNEDY), AUG (FOCH--France), and a APUG (ASW carriers HERMES and ILLUSTRIOUS--U.K.)--all with corresponding escort ships, as well as a KUG (standing NATO naval force in the Atlantic), the standing detachment of minesweeping forces of NATO in the La Manche Strait region), and two KPUGs (one made up of several Dutch frigates and the other of Portugese naval combatants). In addition, AWACS (E-3A) aircraft, NIMROD shore-based patrol aircraft and tactical aircraft of participating countries' air forces participated in the exercise.

Special attention was paid to mine warfare in the convoy staging areas. Minesweepers from the standing sweeping NATO force in the LeManche Strait zone were assigned to sweep the Falmouth exit channels and the convoy staging areas, after which they reassigned to the escort screen. In the Lisbon naval base area, Portugese minesweepers carried out harbor clearance.

An AUG, an APUG, and three KPUGs were assigned for convoy defense of the "moving zone of superiority" (Fig. 2). As reported in the foreign press, cover and deception was employed, and zig zag courses were used. A military liaison officer was onboard each ship to provide any necessary assistance to the captain.

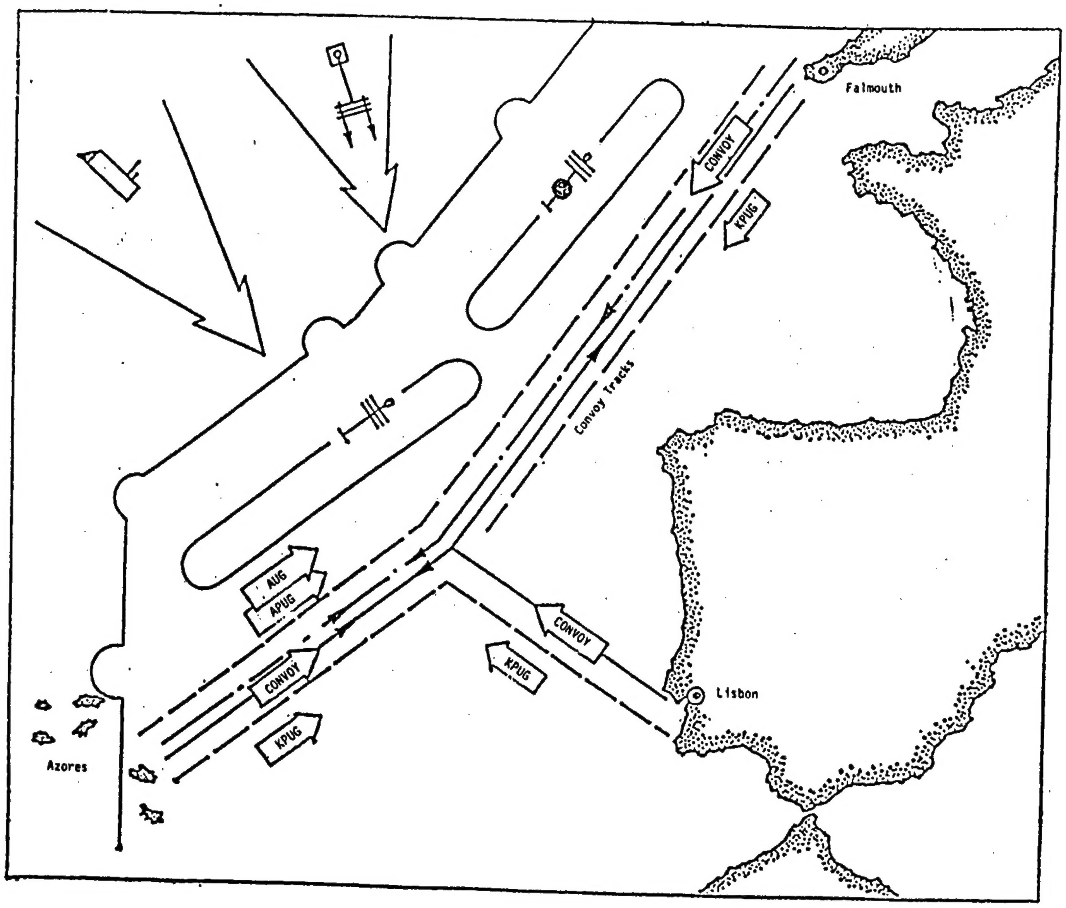

Figure 2. Convoy Defense by the "Moving Zone of Superiority" Method During the Combined NATO Naval Exercise OCEAN SAFARI-83.

For developing the "defended SLOC zone" method, a rectangular region (400 x 200 miles), oriented from southwest to northeast, was set up in the area of the Azores (Fig. 3). It was divided up into sectors each having screen ships with towed arrays. Periodically, the sectors were covered by ASW helicopters. The NATO Atlantic strike fleet and 10 KPUGs were attached, creating ASW and PVO boundaries. AWACS aircraft assisted in these patrols. These detected airborne targets at distances greater than 500 miles from the convoy, and as the foreign press reported, practically not one "enemy" aircraft came within missile launch range.

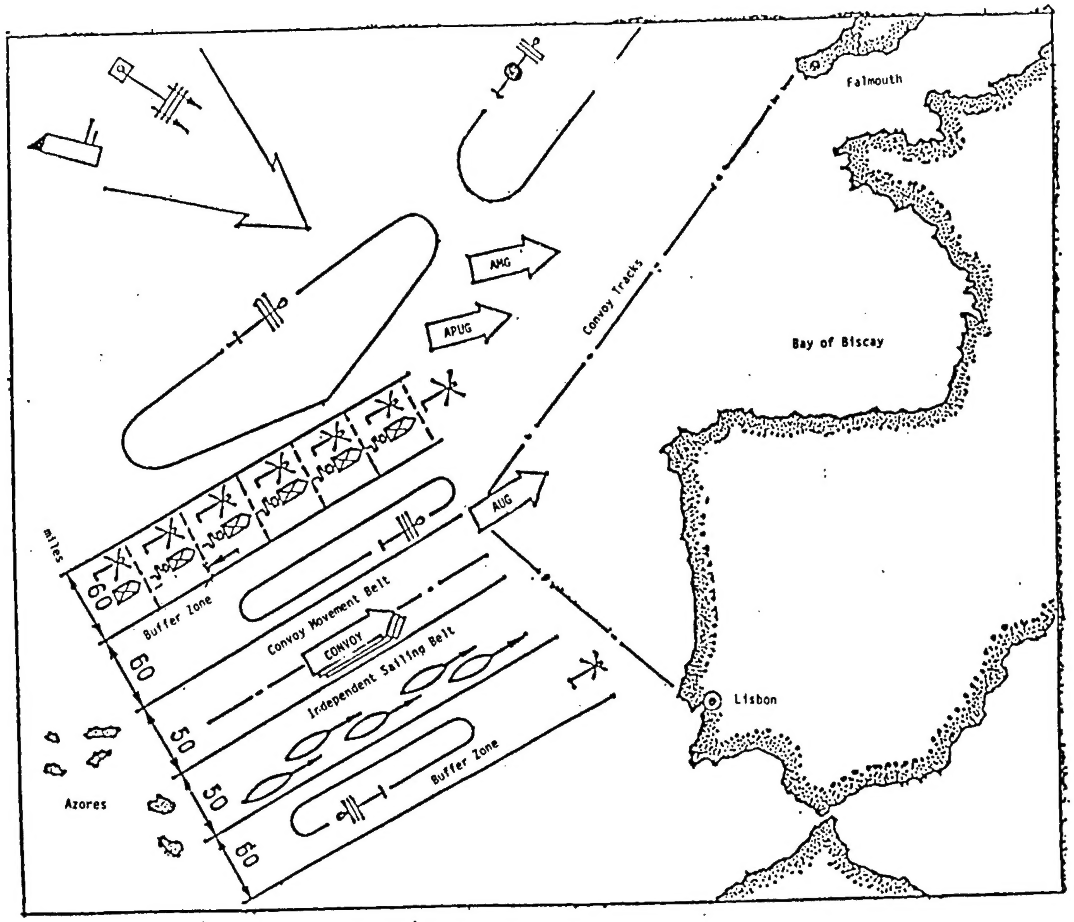

Figure 3. Convoy Defense by the "Defended SLOC Method" During the Combined NATO Naval Exercise OCEAN SAFARI-83.

Foreign military specialists consider that the combination of the "moving zone of superiority" convoy defense method in the open ocean and the "defended SLOC zone" method in the approaches to Europe provide satisfactory SLOC protection and increases the possibilities of supplying cargo and goods with minimum losses.

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